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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

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Look Before You Leap

Some years ago, a young German metallurgist received an appointment to undertake research on the subject of the growth of cast iron. For a whole year he was permitted to do nothing other than make himself thoroughly familiar with the subject by reading every scrap of published information. In this country, whilst a limited amount of time would be allowed for examining past work, the director of any research organisation would insist on work of an experimental character being undertaken simultaneously. The other extreme, that is experimenting without reasonable knowledge of prior work, is perhaps the most reprehensible. We remember meeting during the War, in one of Britain's largest engineering works, a man who was engaged upon the development of an entirely new type of electric furnace. The strange individual confessed to us that he had never heard of Girod, Heroult, Stassano, Electro Metals, Stobie, or the Greaves-Etchells furnaces!

To-day, much effort is wasted by retraversing ground which is already well explored, and it seems necessary to emphasise that whilst it is totally unnecessary, as did our German friend, to read up for a whole year the literature germane to any particular phase, it is logical to take advantage of the existing sources of information. Only recently we referred in this column to the potentialities of caustic soda for desulphurising cast iron, and within a short time we learnt of minor accidents from burns by ardent experimenters. Here is a case where application to the research department of the manufacturers of soda ash and caustic soda would have produced unbiased advice, not only as to handling, but also as to the existing state of the science, comparative costs and all other germane data.

Experiments are often costly and interfere with normal production, and as there are so many sources of information available, it is worth while making an inquiry before spending time, money and energy. One works manager insists that for every major job entering production there must be a statement from the foreman outlining what plant he would suggest if the order was of really large dimensions, and what would be the effect on the production costs. Such a consideration allows the management to ascertain whether some competitive firm is already well laid out for such work and whether experimenting and expansion are worth the trouble, this latter consideration being co-ordinated with the views of the sales manager as to whether his men could procure the necessary business to support plant extensions.

No objection can possibly be raised to systematic experimentation, nowadays designated research, but haphazard trials, prompted by a Press article or simply by gossip, do not make for real progress. Into this category we do include the various compounds offered by the foundry supply industry, for in that case the fullest instructions for carrying out the work are almost invariably given, and a guarantee is offered against failure. Actually some of the newer specifics now offered are quite effective when the conditions for their usage are rigidly maintained. One of which we know is excellent for the purpose for which it is sold, but is potentially dangerous if misapplied, and is illustrative of the type of experiment it is best to avoid. The manufacturers of these proprietary compounds will endorse our remarks that their products are designed to effect well-defined purposes, and are not suitable for general experimentation. Quite recently a fatal accident occurred in a light alloy foundry through what amounted to the carrying out by a labourer of an experiment in the addition of a flux to a bath of molten metal. The proper method of carrying out experimental work is either by co-operation with the laboratory or, where the firm is too small to have such a service, with the help of the service departments of the suppliers of the basic raw materials, or again with the aid of a reliable consultant or research association.

Generally speaking, experiments should not be undertaken until the fullest technical control is established. Not only is this infinitely more important as reacting on a favourable yearly balance-sheet, but there is a *prima facie* case for stating that the results of experimenting cannot be properly evaluated until such conditions of technical control are thoroughly established. One final example—suppose a foundry wishes to experiment with a hot-mould casting whilst ignoring the question of suitable cores. A first-class waster is likely to be produced, yet by prior consultation with the appropriate service bodies such a risk would be minimised and others liable to arise would be indicated. The technical organisation of the industry is such that all foundries, be they large or small, can ascertain free of charge whether any line of experimenting is or is not worth while. Moreover, real help will be given should a chance of technical progress be disclosed.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Some Notes on Machine-Moulding

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Mr. Gale, in his article which appeared on page 93 of the January 20 issue of THE FOUNDRY TRADE JOURNAL, makes an incorrect statement, viz., " . . . the completely automatic moulding machine for the manufacture of moulds is not yet designed."

I know of two *completely* automatic moulding machines which were designed over thirty years ago. One was built by the Berkshire Manufacturing Company, of Cleveland, Ohio, U.S.A., and was completely automatic. This machine put on the boxes, filled them with sand, closed the boxes, and then placed them on the conveyor. It went further—it made 24 cores of green sand and placed them in the correct position in the moulds, simultaneously. This machine made over 1,000 moulds per day of ten hours.

The second completely automatic moulding machine was made by a firm of radiator manufacturers in Kewanee, Illinois, U.S.A., and this machine had twelve pattern-plates. The machine was about 200 ft. long, and it made both the radiator drag mould and the cope mould automatically, without the assistance of man. In this case, the cores were set by hand, but the setting of cores is definitely not moulding, and it is therefore not necessary to include the setting of cores, when mentioning a moulding machine.

The Tabor Manufacturing Company, of Philadelphia, manufactured some moulding machines which were entirely automatic inasmuch as the machines worked the men—the men did not work the machine. The machine in question was controlled by a fractional-horse-power motor, which worked a cogwheel, which completed the various operations in a given number of seconds. In this case, it was up to the man who was being worked by the machine to put on the box in a given number of seconds and take it off in a like manner.

When Mr. Gale states that the real evolution of moulding machines was brought about by necessity of production during the Great War, it is apparent that his knowledge of moulding machines is behind the times. As a matter of fact, the size of moulding machinery has decreased a great deal since the Great War, in the United Kingdom especially, as I personally installed many machines which took a 36-*ton load*, and no machines taking this load have been installed anywhere in the United Kingdom since the Great War.

I brought the *first power moulding machine* into England, 45 years ago, and on this type of machine, in an English foundry, I produced 98 half-moulds in 58 mins.; each mould was 14 in. by 16 in. I placed the box on the machine, filled it with sand, carried the box off, on to the floor and closed it. It is highly probable that Mr. Gale has never seen such production since the War, as men do not appear to work as hard these days.

In Fig. 1 of the Paper Mr. Gale shows what he considers to be the " first type of moulding machine." This type of machine was invented by a gentleman of the name of Pickup, 40 *years ago*; is therefore not new. In any case, Mr. Gale's statement is incorrect, as the first type of moulding machine was made over 90 years ago at the Keighley Works of Darling & Sellars, Limited, and this was a machine to work off odd-sides or a solid cast pattern-plate. The stripping-plate or drop-plate machine was invented by two firms in Lincoln, about the same time, *i.e.*, Clayton & Shuttleworth, Limited, and Ruston & Proctors, Limited, about 85 years ago.

The machines shown by Figs. 2, 3, 4 and 5 of Mr. Gale's article are not actually classed as moulding machines.

Contrary to another statement made by Mr. Gale, I would state that *wood* is the most popular material for pattern-plates—not cast iron. The next most popular material is brass. Again, cast iron is one of the most erosive patterns one can use—because it is the hardest type of pattern to prevent rusting, and therefore brass has a great advantage over cast iron for pattern-plates.—Yours, etc.,

C. W. COLEMAN.
Coleman Foundry Equipment Company, Limited,
Windsor Works, Stotfold, Beds.

The above letter was submitted to Mr. Gale, who replies as follows:

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I am very interested in the remarks of Mr. Coleman about my Paper on machine-moulding, but must say that Mr. Coleman's interpretation of my remarks is at fault in several instances. I have not attempted to give a history of moulding machines as they were introduced, and my comparatively short experience would not allow me to do so; in fact, I mentioned in the Paper that " Machine-moulding was in operation for many years before I had anything to do with the business." Also, I have not tried to pose as an expert on such matters; but, again as stated, I have given a *résumé* of machine-moulding in my own experience.

With regard to the completely automatic machine, I have not yet seen any such machine, and it is interesting to hear that such machines have been in existence for over 30 years. I am very surprised at this, and should like to know why these machines have not been developed and become a feature of modern foundry production.

Mr. Coleman has again misread me when he talks of the *size* of machines. Such features were never mentioned by me in either the Paper or in discussion. Mr. Coleman mentions size of large machines, whereas I referred to the number of machines in use as being brought about by necessity of production during the Great War. I am open to conviction, but I suggest there were *more* machines in use in, say, 1920 than in 1913. When Mr. Coleman says the machines illustrated by me are not really moulding machines, he is " splitting hairs."

Again, Mr. Coleman goes at length to say what production he got from power machines 45 years ago. Surely I never mentioned speed of production in my Paper? He says the production was such as I had probably never seen since the War, as men do not appear to work so " hard " nowadays. I have heard it said that men should not work " hard "; they should work " fast." In any case it is futile to discuss production on any job unless one is fully conversant with the conditions appertaining to that job, but I would mention that since the War I have seen one man make 350 complete moulds per day, larger than those mentioned by Mr. Coleman, entirely on the floor without machine or any mechanical assistance.

Mr. Coleman finally disputes my statement that cast iron is the most popular pattern material for pattern-plates, and we must agree to differ on this point. In my experience 80 per cent. of the pattern-plates are in cast iron, and brass is only used on special jobs, on account of price. Wood is used to make the master patterns from which the pattern-plates are made.—Yours, etc.,

B. GALE.

" Parkdale," Boulton Lane,
Alvaston, Derby.
February 13, 1939.

Random Shots

Another reader, this time from the Midlands, has spent a Saturday evening over last week's problem. Quite definitely Saturday evening, for to such a man surely Sunday morning must be reserved for Torquemada. Indubitably the name of the engineer is Smith. True to last week's promise, however, to give real thinkers a problem worthy of their efforts, " Marksman " has pleasure in presenting the " Monkey Puzzle." Any doctors' bills which can be traced to attempts at a solution should be sent to the gentleman in Scotland, from whom it comes. Whether or not he will meet them is a doubtful proposition. To any sane person, of course, the answer is simple, and guaranteed not to cause a nervous breakdown; the rope should be long enough to hang the author of such a problem and not an inch longer! Here it is:—

* * *

The Monkey Puzzle.

A rope ran over a pulley; at one end was a monkey, at the other end a weight, and the two remained in equilibrium. The weight of the rope was four ounces to every foot, and the ages of the monkey and the monkey's mother together amounted to four years. The weight of the monkey was as many pounds as the monkey's mother was years old and the weight of the weight and the weight of the rope were together half as much again as the weight of the monkey.

* * *

The weight of the weight exceeded the weight of the rope by as many pounds as the monkey was years old when the monkey's mother was twice as old as the monkey's brother was when the monkey's mother was half as old as the monkey's brother will be when the monkey's brother is three times as old as the monkey's mother was when the monkey's mother was three times as old as the monkey's brother.

* * *

And the monkey's mother was twice as old as the monkey was when the monkey's mother was half as old as the monkey will be when the monkey is three times as old as the monkey's mother was when the monkey's mother was three times as old as the monkey.

* * *

And the age of the monkey's mother exceeded the age of the monkey's brother by the same amount as the age of the monkey's brother exceeded the age of the monkey.

* * *

What was the length of the rope?

" MARKSMAN."

Action of Soldering Fluxes

A new publication of the International Tin Research and Development Council, No. 88, is a study on " The Influence of Fluxes on the Spreading Power of Tin Solders on Copper," by A. Latin, Ph.D. The spreading of molten solders over copper under a layer of resin or chloride flux has been examined, and the " spreading power " is evaluated from measurements of the contact angle between the solder and the copper and of the interfacial tension between the solder and the flux. A bluish halo effect around droplets of molten solder on copper is considered to be due to electrochemical deposition of tin from stannous chloride produced by the flux in contact with the solder. The fact that solders spread better than pure tin in either flux is ascribed to their lower surface tensions, but their adhesion is not inferior. The report describes the apparatus used and gives the readings obtained. Copies of the publication may be obtained from the Secretary, International Tin Research and Development Council, Fraser Road, Greenford, Middlesex.

British Industries Fair

FOUNDRY EXHIBITS AT CASTLE BROMWICH

The Castle Bromwich Section of the British Industries Fair, which opens next Monday and lasts for two weeks, is to a large extent the shop window of the light castings industry. By light castings is meant in this case not only builders' castings, but general light engineering and hardware. It is only natural that a number of firms catering for these exhibitors should also take space, especially those whose works are located in or around Birmingham. Below are set out alphabetically descriptions of some of the stands of major interest to foundrymen. In each case the number of the stand is indicated, and by listing these in their group letters before visiting the exhibition, much time and energy can be saved.

PAINT AND ENAMEL SPRAYING

The Aerograph Company, Limited, of Lower Sydenham, London, S.E.26 (Stand No. D277), display a range of stationary and portable air-compressing outfits. These are built to comply strictly with the requirements of the 1937 Factories Act. There are also displays of spray guns for both ordinary painting purpose and vitreous enamelling work; pressure-feed tanks in a wide range of sizes; air transformers and regulators; safety spray booths and vapour-proof light reflectors; exhaust fans for every paint-shop requirement; and air and fluid hose, including a new type of hose that is practically impervious to solvents.

METALWORK PRESERVATION

The Atlas Preservative Company, Limited, of Erith, Kent, have specialised for many years in the problem of keeping the structural work of foundry buildings presentable. With the passage of years, there are now available on their stand (D604) data as to the actual costs and life resulting from the contracts they have carried out for some of the largest foundries in the country. Some recent developments make the question of preserving the ironwork more pressing, and worth-while attention has been given to these problems.

TESTING MACHINES

W. & T. Avery, Limited, Soho Foundry, Birmingham, have on their stand (No. D515/412) a new type of hardness testing machine. This machine gives a comparative hardness of materials by means of direct numeral readings on a dial. The time required for a complete test is only 12 seconds, making the machine ideal for production-testing by unskilled operatives. Since the mark left by the penetrator is so slight, finished articles can be tested without damage.

This machine is supplemented by a self-indicating universal testing machine which is designed for carrying out tests in tension, compression, transverse, shearing and hardness. Though particularly suitable for rapid commercial testing, the speed of the machine is readily controllable, and an extremely slow rate of straining can be obtained. Reliable clear indications of the load applied to the specimen are given on both sides of a graduated chart.

ELECTRIC FURNACES

Birmingham Electric Furnaces, Limited, of Birlec Works, Tyburn Road, Erdington, Birmingham, 24, on Stand Nos. Cb313 and 214, confine their exhibits to the heat-treating side of furnace practice. However, for those interested in melting plant, an information bureau has been organised, where engineers well conversant with the rocking arc and the "Lectromelt" furnaces will be available for technical consultations.

GAS FURNACES

A full-sized conveyor bright annealing furnace, designed by the Incandescent Heat Company, Limited, is shown working on the *British Gas Federation Industrial Gas Exhibit*. It embodies the "Gas Tube" principle of gas firing, which is of real interest to vitreous enamellers, where it takes the place of the muffle system of firing. The "Gas Tube" or radiant tube is a heat-resisting metal tube, in this case about 1½ in. in diameter, inside which the gas and air are burned. The tube becomes incandescent, transmitting heat to the load by radiation and convection without the necessity of heating up an outside combustion chamber and so wasting valuable heat. The inert atmosphere required is supplied from a small unit in which gas is burned and the water vapour and some other constituents then removed from the products of combustion. The conveyor gear of the furnace shown is also notable in that the driven rollers which make up the hearth are made of refractory material throughout, and therefore need no internal cooling. The results obtained are quite remarkable in quality as well as cost, and visitors are invited to bring their own specimens for test on Stand No. Ca611 and 514.

The more everyday uses of gas are represented by an open fired furnace by Gibbons Brothers, of Dudley, for general heat-treatment with an automatic control panel, and by a new recuperative crucible furnace by the Constructional Engineering Company, Limited, Titan Works, Charles Henry Street, Birmingham, 12, for melting non-ferrous metals. A new gas-furnace control panel is also shown for the first time.

MOULDING MACHINES

For the first time for several years there is to be an exhibit of moulding machines, the *Coleman Foundry Equipment Company, Limited*, Windsor Works, Stotfold, Beds, having arranged a comprehensive display on Stand No. D105. Amongst the horizontal core-blowing machines shown is a new model, the R 4 Type, which represents the smallest size made. The range of moulding machines exhibited includes jar-ram squeeze machines, both with and without a pattern draw, and a new type of hand-stripping machine of the drop-plate variety. An interesting range of abrasive cut-off machines has been included, as they are showing increased application in the foundry for cutting off certain types of runners and risers. No Coleman exhibit would be complete without the Prosama sand machine. Another fairly new line is a sand-sifting machine of the electrically-driven suspended-riddle type. To show the potentialities of Tomastone, a number of patterns made from this compound are to be included.

ELECTROMAGNETS

Electromagnets, Limited, of 48, High Street, Erdington, Birmingham, 23, on Stand No. Cb212 are showing the well-known Rotaflux magnet pulleys, as they so often form a part of sand reclaiming plants. In addition they show magnetic shutes for eliminating iron from vitreous enamel slip, magnets for handling pig-iron and scrap, and special plant for dealing with brass foundry tailings.

PYROMETERS

Ether, Limited, Tyburn Road, Birmingham, 24, on Stand No. Cb716, show pretty well the same range as last year, but there has been a modification of the Ether molten-metal pyrometer, with the object of ensuring higher accuracy. The telescopic thermocouple holder and cold-junction location have been the subject of redesign. The range of usefulness is now up to 1,400 deg. C. and is thus well within the sphere of practical application for cast iron, and more than adequate for the light-alloy foundry business.

VITREOUS-ENAMEL FRIT

Ferro Enamels, Limited, of Womborne, Wolverhampton, on Stand No. B209, show a range of frits for vitreous enamels, supplemented by a range of equipment and a model of a vitreous enamelling furnace.

INDUSTRIAL LIGHTING FITTINGS

Because of the Home Office requirements, special attention is directed to the stand of the *General Electric Company, Limited*, of Magnet House, Kingsway, London, W.C.2 (No. Cb515/414), where examples from the range of G.E.C. industrial lighting fittings are being shown. These include units suitable for use with both mercury (including Osira fluorescent) and tungsten lamps and combinations of these. Glassteel, dispersive, and angle type reflectors are also included in the exhibit.

INDUSTRIAL FURNACES

The main feature of *Gibbons Bros., Limited*, of Dibdale Works, Dudley (Stand No. Ca511), is a series of illuminated photographs depicting various plants erected by the firm during the past year. This is a departure from their usual practice of exhibiting a working furnace; they feel, however, in view of the wide and varied nature of their activities, that this year's arrangement will appeal to a greater section of the visitors than a single furnace exhibit could do. Various furnace installations are on view, including types for annealing, reheating, malleable annealing, and vitreous enamelling.

REFRACTORIES

Gibbons (Dudley), Limited, Dibdale Works, Dudley, on Stand No. Ca511, are again showing a full range of their well-known refractories, the various types available being sufficiently comprehensive to cover the bulk of industrial needs. Silica goods (95 per cent. SiO_2) are exhibited in the form of bricks and specials, the very accurate finish being noteworthy.

The "HT-1" brand refractory insulating brick is prominently displayed both in the form of standard bricks and special shapes, and should prove of considerable interest to all furnace users. It is thought that the refractory insulating brick will within the next few years entirely replace firebrick in the construction of heat-treatment furnaces of all types. The exhibit is completed by a range of fireclay and aluminous materials, and super-refractories made from such materials as silicon-carbide, fused alumina and sillimanite.

DEGREASING

Special interest will be given this year to the *Imperial Chemical Industries* metal degreasing exhibit on Stand No. D305 by the demonstration of a totally-enclosed rumbling plant ingeniously designed to cut down the solvent consumption to a minimum. The articles to be degreased are contained in four baskets which are so arranged that at any time one basket is in process of being charged or discharged, a second is inside the plant preparatory to receiving degreasing treatment, a third is undergoing liquor rain and vapour treatment, and the fourth is draining. During the liquor rain and draining phases the baskets are mechanically rotated. By this means the contents of the baskets are thoroughly degreased and "cupping" with its consequent loss of solvent is avoided.

The solvent consumption is still further decreased by a system of semi-cylindrical lids so constructed as to enable the baskets to be emptied and charged without exposing the interior of the plant to the atmosphere. It will be possible to see the process in operation by means of a sight glass.

Two degreasing plants selected from the standard range will also be shown. One of these will be a "Popular" type—the smallest plant on the

standard range—and the other an LV2 model which gives both vapour and liquor treatment. Both these plants will be seen in operation.

HEATING AND MELTING FURNACES

A large stand (No. Cb605/504) has been taken for the four firms in the Incandescent Group, which are the *Incandescent Heat Company, Limited, Selas Gas & Engineering Company, Limited, Metalectric Furnaces, Limited,* and *Controlled Heat & Air, Limited.*

The *Incandescent Heat Company, Limited,* show a cylindrical Incandescent-Lee-Wilson bell-type furnace for bright annealing ferrous and non-ferrous wire and strip in coil form; a rectangular salt bath; a high-speed-steel hardening furnace and a recuperative gas-fired furnace of standard type. The last furnace has chamber dimensions of 24 in. by 18 in. by 12 in. and is of the deep recuperative type. Fired by town's gas under natural draft, this furnace is suitable for all heating and heat-treatment operations up to 1,200 deg. C., and is designed to suit conditions of both continuous and intermittent use obtaining in workshops generally. Efficient combustion resulting in high thermal efficiency is ensured by the special Incandescent multi-combustion chamber system. A live hearth affording maximum heat input to all faces of the work under treatment is a direct result of the controlled combustion which takes place beneath the hearth. An impenetrable gas screen across the door aperture enables the furnace to be operated when the door is open, without danger of an influx of cold air.

The *Selas Gas & Engineering Company, Limited,* show a gas and air mixing and proportioning apparatus for use in conjunction with any gas-fired plant, resulting in complete combustion and consequential economy in fuel costs. Other equipment shown includes:—Natural-draft gas-burner injectors, immersion heating equipment, gas and pressure air burners, gas-fired muffle furnaces, muffle soldering stoves, internally-heated soldering iron, soldering-iron stove, gas blowpipes, laboratory crucible furnace, laboratory bunsen burners, fuel-oil burners, controlled radiant flame burners, laboratory sand bath, and combustion tube furnaces.

Metalectric Furnaces, Limited, show an electric box-type general heat-treatment furnace of 20 k.v.a. rating; a vertical air-circulation furnace, and a model of an electric steel-melting furnace. This model is a replica of a 12- to 15-ton capacity Metalectric-Tagliaferri three-phase direct-arc type melting furnace.

Controlled Heat & Air, Limited, specialises in the manufacture of continuous conveyor and batch-type ovens for all industrial finishes and drying processes, low-temperature tempering and soaking plant, air heaters, air-conditioning and ventilating plant, humidifying and cooling equipment, and core drying ovens. Because of their proportions the units manufactured are unsuitable for exhibiting purposes, and therefore a comprehensive range of photographs depicting the more important types of equipment manufactured is being displayed.

LADLE PREPARATION

Laidlaw, Drew & Company, Limited, of 9, Tower Street, Leith, Edinburgh, 6, on Stand No. D626, are exhibiting a new oil-fired tilting furnace, which follows conventional lines, but owing to the characteristics of the burner, better combustion is secured than is usually the case, associated with a more even distribution of the heat. Two other items of interest to foundries are an oil- and gas-fired ladle heating equipment. This plant has been designed to meet the requirements of all foundries where it is desired to preheat the ladles to a temperature up to 800 or 900 deg. C. This can be done by means of either oil or gas, and at the present time, the firm has a number of large installations in hand for both types of fuel.

All the oil-fired appliances are designed for use with heavy fuel oil. To secure the best results, a special circulating system has been designed, which is operated by the firm's own pumping and heating unit, which will also be exhibited.

AUTOMATIC STOKING

Mirrlees, Bickerton & Day, Limited, of Hazel Grove, near Stockport, on Stand No. B322 show a Mirrlees-Combustioneer firing a Ruston No. 7 Thermax vertical boiler in which the steam pressure is automatically maintained by means of a thermostat, which stops and starts the stoker according to the needs of the boiler. The water level in the boiler is also automatically maintained by a system of Royles float-controlled switches. As the level rises or falls, one switch controls the Mirrlees-Imo boiler-feed pump; the other switches off the stoker when the water fails below a predetermined level. Thus the whole installation is entirely automatic and only needs attention for periodic filling of the hopper and the removal of clinker.

Another exhibit is of a similar stoker, but this time applied to an Ideal sectional boiler fitted with thermostats arranged to maintain the water in the boiler and heating system at any desired temperature. Arrangements can be made whereby the heating system can be changed over by a single tumbler switch to reduce automatically the draft delivery of coal to the boiler so that a low fire is maintained. This is effected either by a separate thermostat set for low temperature or a time switch generally known as a kindling switch.

Mirrlees-Combustioneer automatic stokers cover a very wide range of applications and are made in sizes from those suitable for firing small domestic boilers to large models delivering up to 1,200 lbs. of coal per hr. Their usefulness is not bounded by their steam-raising and water-heating activities however. They are providing controlled heat with economy to many industrial furnaces, including forging, annealing and heat-treatment furnaces, mould-drying stoves and core ovens, vitreous-enamelling furnaces, and the like.

MAGNETTING MACHINERY

The Rapid Magnetting Machine Company, Limited, of Lombard Street, Birmingham, 12, on Stand No. Cb412, are showing an entirely new and improved design of magnetic separator for the extraction of fine particles of iron, etc., from liquids such as enamels. Known as the "Rapid" electro-magnetic percolator (Prov. Pat.), it embodies entirely new features, including the substitution in place of magnet bars having projections and serrations, by fitting on the top of each magnet a box-like frame (detachable for cleaning) containing a mass of woven wire with a small open mesh. A somewhat similar box frame, but slightly smaller, is also fitted intermediately between each pair of magnets, thus filling up the space between each "north" and "south" magnet with magnetic edges. The effect of this is completely to cover the bottom of the trough with a mass of magnetic wire, making for the purpose of description a sectional mattress of wire sponge through which the liquid must percolate. As the cross-section of the woven wire is flat, many thousands of feet of magnetic edges are produced, and it is estimated that on an apparatus 24 in. wide by 6 ft. long, there are 4¾ miles of magnetic edges (without counting the edges of the holes in the box frames, which are also magnetic), against approximately 5,000 in. in the old type.

In operation the liquid is fed on to the trough in the usual manner and passes through all the magnetic "sponges" successively in a similar manner as it would pass through a percolator. This machine is made in various sizes to suit the material to be treated and the capacity required. Also, it is impossible for the magnets to choke up and cause a reduction of flow, as is the case when the flow is vertical and restricted to a very small area. To demonstrate this apparatus the firm have arranged for the circulation by means of a rotary pump driven by an electric motor of potters' slip over the machine.

Other exhibits include a self-cleaning shute-type separator; a "V" magnetic separator, comprising a vibrating shute containing a series of magnet bars, and almost noiseless; and one or two types of the patent "Biaflux" drum machines, a large number of which having been supplied for handling foundry sands.

AUTOMATIC STOKING

On Stand No. D222, *Riley Stoker Company, Limited,* of 40-43, Chancery Lane, London, W.C.2, are exhibiting the Class "B" 7 underfeed stoker, which has been specially designed to fire the larger boilers now being put forward by boilermakers. It can be arranged for automatic control by pressurestats or thermostats, and is designed to burn a maximum of 850 lbs. of bituminous coal per hour. It can be fitted into flues of 3 ft. 4 in. dia. and upwards.

A second exhibit is the Robot industrial automatic stoker (No. 10 size), which is suitable for firing vertical cross-tube boilers, locomotive boilers, and various sectional boilers, and for industrial steam boilers. The No. 2 size Robot automatic stoker is suitable for firing vertical, locomotive and sectional boilers for central heating and hot water.

All Riley stokers are heavily constructed, the main body, the fan and the air-ducting being built in cast iron, while the air chamber is formed within the body of the machine, no brickwork for the air chamber being necessary. A unique feature is the exclusive automatic control applied whereby the rate of feed of both coal and air is regulated automatically to suit the load on the boiler and a high efficiency of combustion is therefore maintained at all loads. Another feature is that a surrounding grate is fitted wherever possible. With this grate the boiler can be hand-fired should there be a failure of the electric supply or driving motor.

PIG-IRON

Quite a few of the great blast-furnace owners have stands at the exhibition, but in the main they are devoted to the showing of steel tubes and cast-iron pipes and joints, but the major factor is that there are to be experts available for discussing the composition and properties of the various makes of pig-iron. The stand number of the *Stanton Ironworks Company, Limited,* is B717 and 626, and the firm has a particularly wide range available. The *Staveley Coal & Iron Company, Limited,* are located on Stand Nos. B517 and 416, and *Stewarts and Lloyds, Limited,* on D501 and 460. The latter firm also shows a range of ganisters for cupola daubing and ladle linings.

REFRACTORIES

John G. Stein & Company, Limited, of Bonnybridge, Stirlingshire, are located on Stand No. D303, and, generally speaking, their exhibit is divided into four sections. The first covers magnesite and chrome bricks, the second fire-bricks, wherein are featured Nettle (42 to 44 per cent. Al_2O_3) and Thistle (35 to 37 per cent. Al_2O_3); the third high-alumina bricks which take the range from 63 per cent. Al_2O_3 to Sillimanite; and finally there are silica bricks covered by the Myrtle and Bluebell brands.

PIG-IRON

The United Steel Companies, Limited, on Stand No. D613/512, feature "Silver Fox" new-process stainless steel, extensive use of which is made in the decoration of the stand. The exhibit of major interest to foundrymen, however, is that of special pig-irons. These are machine-cast to add still further to the admittedly high quality of the West Coast hematite irons.

(*Concluded on page* 153.)

A Short Paper Competition

The January meeting of the Junior Section of the Lancashire Branch of the Institute of British Foundrymen took the form of a Short Paper Competition, in which the following Papers were submitted:—(1) "Moulding of a Cast-Iron Mould," by Mr. C. Redfern; (2) "The Use of Artificial Venting," by Mr. H. Jackson.

A DOME-SHAPED CASTING

MR. REDFERN described the moulding of a cover casting, nicknamed by his work mates the "crash-helmet" on account of its shape. He first of all rammed the mould in green sand, and placed it on a board. The top part was rammed first as the machining was in the bottom. Wooden bars and gaggers held the sand in the box, which was turned over and formed a joint. Sand was sieved in the bottom of the cover and lined the sides. Cinders were put in the bottom, and a vent drawn off by placing a tube from the cinders to reach above the box part which was the bottom of the mould.

The core and box part were rammed up, the two boxes clamped together, turned over, and the clamps removed. When the top part was lifted off by a crane, the pattern came up in the top, and left a clear draw of the core and machined rim. The pattern was withdrawn and the mould was blacked and closed. When casting, a plate was put over the riser; this stopped the air from rushing and dragging the core with it.

A Run of Wasters

Three castings were satisfactory, but the fourth scabbed. It had been rammed with a sharp rammer to a parting. The fifth also scabbed. Various explanations were given, such as:—(1) There were no sprigs in front of the runner, and by constant blowing of metal on the core the sand was burnt and washed up; (2) the wooden bars were too near the face of the mould; (3) there was too much sleeking. The sixth casting swelled as a result of soft ramming. However, by changing over to dry sand, the trouble was remedied. From this experience the speaker learned a great deal.

DISCUSSION

MR. A. L. KEY thought the trouble was the cinders were too close on the top. The proper place for the cinders was at the bottom, venting from there to the top of the core.

MR. REDFERN recalled that the first three castings were good, but for them he did not have a tube. They were vented with needle wire. With a tube, bad results occurred, and the top showed marks of dirt, proving that the sand must have been burnt. When made in dry sand, the job was all right.

Cinder Elimination Suggested

MR. KEY said there was no great difficulty experienced with the core providing the sand was of the correct density. Personally, he would put two long gaggers in at the bottom, tamp the sand halfway up, and would use no cinders at all. He would mark the top of the box where the binding was, and vent, as near as he could, an inch all the way round. He thought there would be no trouble with this method.

MR. REDFERN thought that the cause of the scabbing when he was casting was the terrific rush of air, which had probably dragged away the core. Was it better to have a lid on the top to keep the rush of air in?

MR. KEY remarked it was not essential, but was an advantage. If the volume of air could be kept in, the metal would not scab.

MR. REDFERN said that green sand riddled was better than green sand sieved, the latter being too close.

Type of Sand for Coremaking

MR. KEY explained that a fairly open sand must be used to make a core successfully. Black sand would serve, but the sand must be on the dry side, and must have bond. When handled it should feel gritty. If, after examining the sand, the hand was clean or dry, then the sand was in the best condition; but if the hand was muddy or sticky, and the sand stuck to it, the sand was too wet for the job.

MR. HILL could not understand why the job should not be made in green sand. Jobs more liable to scab than the job referred to were made in green sand successfully.

MR. KEY agreed. It was a matter of having the right sand and tamping or ramming correctly. He referred to a large rectangular condenser with 7 to 9 inches of solid material on top of the vent, and said that if the top of the core was stamped on to hold the brickwork together, there would be that amount of loam or sand on top of the grid. If ashes were put on top of the grid the top would probably be blown off the core. Such a large reservoir was not strong enough to resist the pressure set up by the gas.

A Fresh Method Suggested

Finally, MR. KEY said he would have simplified the job by making it the reverse way. The pattern would have been exactly the same. One end would have been carried out in dry sand and the other in green sand. Across the top there would have been two bars and two pieces of packing and two wooden wedges. The only vent would be a $\frac{1}{8}$-in. hole at the centre of the core and 3 in. at the top. There should be free open sand with plenty of horse manure in it.

VENTING

In the second Paper MR. HARRY JACKSON described venting as an artificial means of increasing the natural permeability of the sand. If gas could not get away from the surface of the mould it would either blow through the molten metal and cause a blown casting, or it would pack under the surface of the mould and the pressure of gas and steam at that point of the mould would blow off the surface sand. This would cause a scab on the resultant casting.

Special care should be taken in the venting of green-sand cores or parts of moulds surrounded by metal. These parts could be vented by pushing a wire right through the sand to within an inch of the pattern, or by ramming up with the mould a number of rods or thin wires which were withdrawn when that part of the mould was rammed up. This method assured a direct vent from the surface of the mould to the atmosphere without causing any damage to the pattern.

It was equally important that vents should be provided to carry away the gas from the cores and prevent the iron filling the vents of the cores. In the venting of protruding parts of cores, where a straight rod could not reach, a wax vent was rammed up. This consisted of a thin string surrounded by a coating of wax, the wax being burnt away in the process of drying. The centre of a large core was generally rammed up with coke, which, being of a very porous nature, afforded an excellent vent. It reduced also the amount of ramming, helped the core to dry quicker, and less sand was used in the production of the core.

Coke beds could be used in the making of moulds, being connected with the atmosphere by vents or pipes through the sides of the moulding boxes. Dry-sand moulds required less venting than green-sand moulds, as most of the hygroscopic moisture in the sand was driven off by the drying process. There would be less steam generated in the sand when the mould was cast. Consequently, fewer vents would be required in the mould. Loam moulds required practically no vents at all; the moisture had been driven out of the sand, leaving it very porous.

DISCUSSION

MR. HILL'S experience had taught him to do without wax vents if at all possible. With taper vents he sometimes found the wax had not melted and the vent was blocked. The job might proceed normally for three or four seconds after taking the ladle away. Then blowing would occur. He mentioned an instance of venting on a job which was done without any trouble. There was a large flange across the top, about 2 ft. 9 in., which came down in a bell shape with a bracket on each of the four sides. When the blue print came in for a quotation to be made, it was apparently a difficult job which would take two days to cast in green sand. It was found that if the patternmaker made a core box the job would be simplified. The casting weighed 6 cwts. It was rammed up in green sand and a plate was cast in open sand to make the joint to bed it in. In casting this open plate only one or two irons were necessary in the corners. One or two vents were put there. He rammed up to the top joint. A little joint was made round the bracket. A piece of flat slab core was used to take out that part. It was taken round the top, the pattern bedded in, and the flat top rammed up to do away with the core.

The core instanced was made in green sand in a core box of six segments. No cinders were put in the middle of the core. Core irons were run with a bar through the middle to hold it. When ramming the core, long vents were put right down to the core. No sprig was put on the core; just enough space was left on the plate at the bottom to run it with finger gates. The job was perfect; there was not a scab on it.

Discretion had to be exercised in ramming the core; it should not be rammed hard. The job in which scabbing had been experienced would have been successful if, instead of ramming, the sand had been pressed with the fingers. Good vents should be made at the bottom. All that was necessary was to make an imprint with the fingers in the sand. If there was a uniform ram, no trouble would be experienced. It was when there was a hard spot and a soft spot that trouble occurred.

British Industries Fair

(*Concluded from page* 152.)

ELECTRIC FURNACES

Wild-Barfield Electric Furnaces, Limited, and *G.W.B. Electric Furnaces, Limited*, on Stand No. Cb303/204, show electric furnaces of many different types, ranging from laboratory muffles to furnaces for industrial use. The small furnaces are shown in several different types, covering a wide range of laboratory requirements. In addition some of these furnaces are suitable for works use for hardening small tools, etc., and are in great demand due to their robust construction and reliability. For low-temperature treatments below 700 deg. C., two sizes of vertical forced-air circulation furnaces are being shown. One furnace, fitted with the charge progress recorder, is intended for production, the other smaller model of simplified design for tool-room and experimental purposes. Both sizes are fitted with a patented centrifugal fan which gives a high output of work and very close temperature uniformity. The well-known Vickers pyramid hardness testing machine is also being shown. The furnaces manufactured by G.W.B. Electric Furnaces, Limited, being too large to exhibit, numerous large photographs of installations are shown instead.

D

Loam-Moulding Practice

DISCUSSION ON MR. R. D. LAWRIE'S PAPER

Some interesting phases of essentially practical foundry practice were brought out during the discussion on Mr. R. D. Lawrie's Paper on "Examples of Loam Moulding," when he presented it to the Lancashire Branch of the Institute of British Foundrymen. The Paper was printed in our last two issues.

Vote of Thanks

Following the reading of the Paper, MR. A. L. KEY proposed a vote of thanks to Mr. Lawrie for his excellent lecture, which should convey to anybody not thoroughly acquainted with loam moulding the amount of effort, foresight and knowledge which was required to produce successfully castings such as those which had been described. One great difference between arranging to make a casting in loam and a casting in sand was that, with loam moulding, practically everything had to be constructed. When the drawing was received, the casting had to be visualised in the finished condition, and the various lifting weights involved had to be calculated and allowed for. Moreover, tackle had to be designed for loads with irregular distribution of weight, to obtain easy handling.

MR. W. HOLLAND, seconding, said he did not know another foundryman in the country who had had more experience than Mr. Lawrie in such work. The Branch would welcome an early return visit from him.

The vote of thanks was carried unanimously, and MR. LAWRIE briefly responded.

DISCUSSION

MR. HOLLAND asked whether the bend casting was rammed up in a pit before casting, after it had been bound down.

MR. LAWRIE replied that it was rammed up partially, although it was not considered necessary; after all, the four corner pieces took care of the holding of the job together. It was lightly rammed up round the longer side simply to prevent people falling into the pit.

MR. A. PHILLIPS referred to the boring bar, and asked whether any packing pieces were placed at the bottom of the pit, or whether the box was sufficiently strong to take the strain, because it seemed to be a heavy sectioned casting at the bottom. He did not notice any stoppers on the runners. Were they used, and, if so, of what type?

Mr. Lawrie had only stated the composition of the castings, but he would agree that this was not everything. The make-up of the charge was of more importance in getting a good casting, and he would like to hear something of its nature. Did Mr. Lawrie loosen the round runners on the top to help in the contraction, or did he leave them as they were, and release a plate?

Casting Details

MR. LAWRIE replied that the box was sufficiently strong to withstand any pressure. The boxes were all 2 in. thick, and, as shown in one of the illustrations, the box was suspended on two bars running the length of the box. There were no stoppers. The gates were all covered by pieces of tin, 6 in. square. As the material was used in conjunction with the Meehanite patented process, he asked to be excused from detailing the composition of the charge. He had omitted one point regarding the running of the boring bar; there was an 18-in. head on the casting. The casting was continued parallel for 18 in., and at a point where the casting finished and the head began there was a flow-off riser. When the metal came to the riser, it overflowed and the head was allowed to drain itself. The hole was botted up, and the head was supplied with fresh hot metal to permit of progressive solidification. After the head had set, the pouring basin was lifted off, and, being semi-plastic, it pulled itself away, so that the runners were left free and sticking up from the top of the casting. Both the boring bar and the bend pipe weighed 25 tons.

Drying *in Situ*

MR. E. LONGDEN, having had considerable experience of that class of work himself, said he was sure that Mr. Lawrie was working on the very safest lines possible. The company with which he had been associated was obviously well supplied with the essentials for making such work, and particularly with excellent cranes. He should imagine the firm had a 100-ton capacity crane to lift the heavy loads. He had in mind the bend casting, where they lifted a heavy mass of material. He, personally, would not lift such a mass of material, but would dry it on site. His firm dried very effectively much heavier masses *in situ*; a worthwhile amount of labour and tackle would thus be saved. Actually, the tackle for the bend casting must have been much greater than the weight of the casting itself.

It had been pointed out that there was an 18-in. head on the boring bar, and that this head had been fed early. It was evidently sufficient in the way which it had been treated, *i.e.*, to supply it later on with hot metal. Otherwise, to his mind, it would be hardly sufficient. No one could question the method of making either of the two castings, which were highly craftsmanlike accomplishments.

MR. LAWRIE said they had a 60-ton and a 30-ton crane, and the bend was lifted by the 60-ton crane. No more tackle was required for lifting the job into the stove than would have been required for making in the pit. The bottom plate was essential, and as he had to make one, he provided it with lugs, so that it would not only make the bend pipe, but could be re-used. It had, in fact, been used later for planing-machine tables.

Local Considerations

MR. LONGDEN suggested the bottom plate was not essential, as much heavier work had been done without a plate.

MR. LAWRIE agreed that that was possible by putting the bars in the pit. Fortunately, he had had stoves 36 ft. long, 12 ft. high and 20 ft. wide, and could dry more efficiently and quicker in a stove than on any floor.

MR. LONGDEN asked whether one was justified in making the tackle, which would be of greater weight than the casting itself.

MR. LAWRIE: The bottom plate weighed 30 tons and the casting 25 tons.

MR. PHILLIPS suggested that the foundry being against the river was the reason why the job had been dried in the stove.

MR. LAWRIE agreed. He added that the bend casting was made in the pit, and dried with two portable driers. The prime reason for the first casting being dried in the stove was because the pit was 7 ft. deep, and during the initial excavation a labourer was seen putting a bar into mud in the pit bottom, so that there was no point in drying the mould and drying the river at the same time! With regard to the head, the casting was continued for 18 in., and filled with hot metal, so that it was progressively fed from the bottom upwards.

MR. LONGDEN said the provision of appropriate tackle of suitable height in a foundry was very important. His firm, he said, had on hand at the moment three boring bars, the largest of which was 20 in. in diameter and 47 ft. in length, and, because of its length, had been cast flat on the floor. It was far more hazardous to cast on the flat than on end.

Run-off Risers

MR. KEY was rather surprised that Mr. Lawrie did not amplify his explanation of the run-off riser. It was possible, even although that tackle looked robust, that, had Mr. Lawrie failed to run without having an easing riser, probably, with the bolts that he had, the staple would not have been strong enough to hold the job. He recalled three hydraulic cylinders which were moulded on the flat and cast on end. The first two, when cast, burst in the pit. The third one the foundry determined should not burst. Four moulders and four labourers were busy for three days putting in bars, bracing, strapping and bolting. A safe lift was obtained, but as soon as the metal reached the top, the mould burst. That firm realised they could not make those particular castings, and gave out the work to another foundry, which made some very good castings. Upon the customer finding out, he insisted on the original firm making them. It happened that he (the speaker) then joined the original firm, and he asked to have his own way on the job. He worked along similar lines to those outlined by Mr. Lawrie. He procured two boxes, 32 in. long, and put a flow-off riser, which measured 6 in. by 2 in., three inches from the top of the head, which was 2 ft. deep. He controlled the pouring, and as soon as the metal came near the riser, he stopped pouring and ran off into a trough. Two castings were successfully made. After he had left he heard that the management returned to the system previously used with disastrous results.

The point of this experience was that, until the mould was filled, one only had what might be described as the ordinary specific weight, but with the metal rising, there were additionally dynamic conditions. As soon as the metal reached the top, the flow was arrested, and according to the height of the ladle, which increased the effect of height, there was a check in flow which caused a sudden rebound. Unless the boxes were exceptionally powerful, it was courting disaster. He had not cast a job on end for many years; nor had he allowed the box to be filled to the top, because he had seen many jobs fail in the same way. He thought that was the main reason why Mr. Lawrie did not fill his box to the top.

Conflicting Theories

MR. LAWRIE said that Mr. Key's suggestion was entirely wrong. The flow-off riser was definitely to carry off the dull, sluggish iron, on top of which there was always a certain amount of scum and dirt. He could quite easily cast such a job without a flow-off riser, and had done so. An interesting point, however, had been raised. There was a mould with the core coming right through, and a ladle pouring metal into the pouring basin and dropping through gates to the bottom. In this particular case the pressure was over 100 lbs. per sq. in. at the bottom. Mr. Key said that the height of the ladle had to be taken into consideration. With this he entirely disagreed.

MR. LONGDEN drew attention to the momentum of the metal.

MR. LAWRIE said that the height of the ladle could not be correlated with the pressure. Speaking of the pressure, the static pressure was calculated from the highest level in the pouring basin, and not from the lip of the ladle. The municipal engineer would say that the pressure at any point was so much per sq. in., simply because he calculated the difference of height between that point and the level of the reservoir whence the water was flowing. According to Mr. Keys' theory, the municipal engineer should really take as his topmost level, not the reservoir level, but the heavens from which the water came!

MR. KEY differed from Mr. Lawrie. If an ordinary flat top-box, with fire bars in it, and with sufficient weights placed on top to hold it down, was poured and filled, nothing would happen. If, however, men elevated the ladle and continued pouring, what happened? The top would be lifted off.

MR. LONGDEN said that the stream of metal at the top of the head exercised a greater momentary pressure due to momentum. He thought both Mr. Key and Mr. Lawrie were right.

MR. PHILLIPS also thought the two opinions were correct, and gave figures showing the serious effect of gravity and momentum.

Loam Mixtures

MR. J. MASTERS (Shrewsbury) said he had had a great deal of experience of casting jobs of extensive length, and had never taken the metal to the top if it could be avoided. In Mr. Lawrie's opinion, was it necessary to have two separate mixtures of loam for the large boring bar? It was appreciated that the difference between the pressure at the bottom and at the top of the mould was very marked, and his rough estimate was 200 tons pressure at the bottom of the mould. Did Mr. Lawrie radius on the bottom of that bar and the joint, or did he bring it up dead square? A 12-in. section of the bottom had been shown; was that radiused off to break the strain?

The PRESIDENT asked whether Mr. Masters meant the avoidance of the knife-edge effect of the metal.

MR. MASTERS agreed.

MR. LAWRIE said the same loam was used throughout for the mould and the core. The loam used in Ayrshire was made up from two parts of local river gravel to one part of gravel found on the shores of one of the inland lakes, ground in a pug mill for 20 minutes to develop the bond. If a pebble taken from river sand was broken, concentric rings could be seen, which were caused by the action of water and clay over many thousands of years. When these pebbles were ground, the clay bond was brought out; it was curious where it came from, but the bond was present on milling.

MR. MASTERS asked if any bonding material such as manure was used.

MR. LAWRIE said it was not. Although sand experts would declare that there was no permeability in loam, in his opinion there was a certain amount.

Contraction of Meehanite

MR. PHILLIPS asked, when making a bend in ordinary cast iron, whether the same amount of easing should be afforded as with the example described.

MR. LAWRIE said there was no difference in the contraction of the Meehanite used and ordinary cast iron, and he, personally, would make it exactly the same. It would be appreciated that that job made in ordinary grey cast iron would contract considerably, and would require the same attention as did Meehanite.

Steam Feeding

The BRANCH-PRESIDENT said mention had been made of feeding. Had Mr. Lawrie had any experience of steam feeding? He (the speaker) had visited a Scottish foundry and found a very good illustration of the advantages of steam feeding. As a result, his firm had put the idea into operation, and experience had proved its worth in certain cases. Did Mr. Lawrie think this method would help in a job such as that referred to, to avoid rod feeding? Many castings required feeding for a considerable time—in some cases hours, which involved fatigue of the men.

MR. LAWRIE had not had experience of steam feeding. He had never rod-fed a boring bar, hydraulic arm or cylinder, but used a feeding head. For the bend, the risers were certainly above the flange. The four corner flanges were fed by rod-feeding, but wherever possible he tried to eliminate this procedure, because very few moulders could do it. Instead, he designed a riser which did the feeding itself, and which remained liquid until the casting had set.

The BRANCH-PRESIDENT said steam feeding had been detailed in a Paper* presented to the West Riding Yorkshire Branch of the Institute. He thought that method would prove advantageous in many instances where, at the present, recourse had to be made to hand feeding.

MR. LONGDEN asked why there was recourse to chaplets in the bend.

MR. LAWRIE said they were screwed studs of ¾ in. dia. with a piece of hoop iron on top.

Dirt in Riser Metal

MR. A. SUTCLIFFE wondered whether Mr. Grundy had ever cast a flat plate. If he examined the runners he would probably find that they would be a short distance down. A very little time after casting it would be found that the short distance referred to had disappeared, which explained that feeding by putting on the cold plate carrying loam. It stopped the metal from coming back. Mr. Lawrie had referred to dirt coming up a riser, and the speaker thought that was a mistake. The only dirt which came up a riser was what was underneath it. Mr. Lawrie had backed the casting with two wood baulks. He did not like this method, because of the fire hazard.

MR. LAWRIE, referring to dirt in the riser, agreed that the riser never took away dirt unless it was directly beneath it. He had said there was a riser at each corner, but he also said they were designed so that dirt originating there would go up these risers.

MR. SUTCLIFFE: Some of the dirt.

MR. LAWRIE said that most of it rose. When the risers were chipped off there was no dirt at all; they were clean all over. The width of the flange was 6 in., and the riser was 9 in. or 10 in. at that point. As to timber baulks catching fire, there was 12 in. of loam below and 12 in. of bricks and loam above, thus yielding little or no heat. With regard to the question of gates going down and up, he referred members to an excellent Paper given several years ago by Mr. Dorsie, of the Scottish Branch, on light casting problems, in which were given the results of experiments carried out with ordinary rain-water gutters, with indicators on the ends, showing how much they went up and down.

MR. LONGDEN said the explanation was that there was an evacuation of gas from the mould. The shell expansion caused the sinking of the mould.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

493,633. ROBERTSON & COMPANY, LIMITED, W. H. A., and BOURNE, A. J. Cold-rolling mills.

493,701. PRISTON, H. R., HOTHERSALL, A. W., and BRADSHAW, W. N. Electro-deposition of tin.

493,731. BRASSERT, H. H., and BRASSERT & COMPANY, LIMITED, H. A. Refinement of steel.

493,741. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Method of joining metals together by electric resistance welding.

493,772. LINDE AIR PRODUCTS COMPANY. Method and apparatus for cutting and heat-treating metal.

493,838. BLAKEBOROUGH, R. A., KLOUMAN, F. A., and GARRATT, W. R. Method of rendering cast-iron immune from attack by sea-water.

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* "Feeding of Castings, with Special Reference to the Steam-Pressure Method," by B. Hird. FOUNDRY TRADE JOURNAL. Vol. 58, 1938, pp. 195-6.

East Anglian Foundrymen's Dinner

MR. J. HEPWORTH ON TECHNICAL EDUCATION

The third annual dinner of the East Anglian Section of the Institute of British Foundrymen was held at the Crown and Anchor Hotel, Ipswich, on February 2. Col. C. Portway (President) was in the chair, supported by Mr. J. Hepworth, M.P. (President of the Institute), Mr. M. W. Garside, Mr. H. H. Shepherd, Mr. Hall and Mr. J. L. Francis. The company numbered some 60 members.

In proposing the toast of "The East Anglian Section," MR. HEPWORTH said he wanted first of all to thank the members for their kind invitation and the hospitality that they had extended to him. It has been customary in the past for the people of this country to give their children the best education they could afford and, unfortunately for industry, they had been satisfied with a classical education. He had felt for some considerable time that the technical side of education had been considerably neglected. He had heard that there were 14 tramcar conductors in Birmingham who had taken a University degree. That was an unfortunate situation, but we could only absorb in this country so many graduates. The reason he mentioned this was because he wanted the young men to develop technical education as well as classical. As a manufacturing nation, and if we wanted to keep our markets, we had to get the best brains in industry that it was possible to get. We lived by export; he had said on many occasions that our export trade was as vital as our rearmament. He hoped that the East Anglian Branch would develop the technical side of education, because it would be to the advantage not only of the Institute, but of the rising generation, and a great advantage to industry as a whole.

COL. C. PORTWAY replied to the toast, and said he had apologies for absence from Mr. C. C. Booth, Mr. W. B. Lake, Dr. A. B. Everest and Mr. Brazier. The feeling in the Section was all that it should be. As a Section, they had only a Colonial status, but realised that it was by their own efforts that they might rise and become a Branch. The Section was happy to be under the protection of the London Branch, and he was very glad to see so many members of the Branch with them that evening. The Section had had a very successful year. The number of members had risen slightly to 56. He thought members realised how much they owed to their indefatigable secretary, Mr. J. L. Francis, who organised all the visits, lectures and affairs such as was held that evening. In passing, Col. Portway offered sympathy to any of the members who lived in the flooded area of Ipswich.

The Guests

MR. H. H. SHEPHERD (Senior Vice-President) proposed the toast of "The Guests."

MR. M. W. GARSIDE, responding, said he was delighted to hear Mr. Hepworth's remarks about technical education. He thought that the recently published Spens Report would remedy defects. If that Report were adopted, it would certainly give the opportunity of creating highly-educated technicians. Mr. Garside added that if there was anything at all that he could do to help along the work that the Institute was undertaking, he would be very glad and willing to give that help. He was hoping to have some extensions made to his institution, and there would be provision in those extensions for foundry work to take place. If some firm in the region of Colchester would offer facilities in the works, he would see that a teacher was available.

The company were entertained by the "Regina" Concert Party and Mr. H. Fox.

E

Selection of Cupola Blowing Equipment*

By S. D. MOXLEY and W. THOMAS BARR

It is the intent of this Paper to consider only the engineering, maintenance and economic factors which are important in the selection of cupola blowing equipment, once the engineer is furnished with the metallurgical and operating requirements prevailing in the shop. It is assumed that the metallurgist and foundryman would specify these operating conditions, and then expect the engineer to analyse the mechanical and electrical equipment involved in serving these needs. Such questions as proper cupola operation, the value of automatic controls from an operating standpoint, and other similar operating questions are beyond the scope of this Paper.

In the foundry, nothing is more important than the melting of iron. To maintain maximum production the melting unit must be able to furnish the proper quantity and quality of iron at the required temperature at all times. It should be flexible enough to meet the varying operating conditions during the shift and from day to day with maximum efficiency and economy.

To accomplish this, the blowing equipment of the cupola must be adequate and flexible. The importance of adequate control of the amount of air for combustion of the coke in the cupola is obvious when it is remembered that the amount of air, by weight, discharged into a cupola exceeds the weight of all other materials charged into it. Adequate control of air is one of the best tools in the foundry for successful operation.

Types of Blowers

The engineer and foundryman are offered the following types of blowing equipment.

(1) Positive displacement	Constant speed	Bye-pass. (Manual or air-weight.)
(2) Positive displacement*	Adjustable speed Direct current.	Manual.
(3) Positive displacement	Multi-speed	Bye-pass. Manual.
(4) Positive displacement	Steam-driven	Bye-pass or speed control. Manual or automatic.

The above with or without flow-meters.

* Tachometer measurement of volume.

(5) Centrifugal	Single-stage	Manual or air-weight.
(6) Centrifugal	Multi-stage	Manual or air-weight.
(7) Centrifugal	Adjustable speed Direct current.	Manual or air-weight.
(8) Centrifugal	Steam turbine	Governor.

Characteristics

The positive-displacement blower is basically a low-speed machine. In operation it develops only that pressure which is necessary to overcome the resistance in the cupola, wind pipes, etc. Its pressure limitations are the strength of the casing and size of the motor driving it.

Centrifugal blowers depend upon impeller speed for pressure, and each tip speed of the impeller develops a definite pressure in the casing of the blower. Hence, with the impeller speed constant, the blower develops air at its top pressure regardless of the pressure being used in the cupola. Since centrifugal blowers are usually furnished with constant-speed motors, they operate most economically when operated at their rated pressure. In hot climates temperature will somewhat lower the top pressure a centrifugal blower will generate. The blower should be purchased to deliver the required pressure during the hottest weather and lowest barometric reading.

Both the centrifugal and positive-displacement blowers readily lend themselves to automatic volume and air-weight controls. Manually-operated volume controls are used satisfactorily with either type of blower.

Space Requirements

Much more floor space is required for the positive-displacement blower than the centrifugal, as the latter is a very compact unit. The centrifugal blower is lighter in weight and its foundation is simple. Hence, the foundation or platform on which the blower is to be mounted usually is less expensive.

Controls

The usual types of controls to be considered are as follow:—(1) Bye-pass—manual or automatic; (2) adjustable-speed d.c. motor—manual control; (3) blast-gate—manual or electric control; (4) blast-gate—operated with compressed air, and (5) variable-speed steam-engine drive—manual or automatic.

The bye-pass type valve is used with the positive-displacement constant-speed blower. The blower is operated at a speed which will deliver the maximum amount of air required, and the bye-pass valve is used to bleed out of the air-duct a portion of the air which, in turn, controls the amount of air being delivered to the cupola. These valves are sometimes operated manually while others are of the motor-operated type with remote control. Both of these types have been thoroughly proved in practice.

The blast-gate control is used with centrifugal-type blowers. It consists of a butterfly valve mounted in the intake or outlet of the blower, and the position of the gate controls the amount of air entering or leaving. When manually controlled the gate is clamped in a position that will allow the required amount of air to pass through the intake or outlet of the blower. The position of the gate can be easily and quickly adjusted from time to time to change the air delivery to suit the operating conditions. An ammeter calibrated in weight of air delivered, installed in the motor circuit, serves as an accurate air-meter.

The electrically-operated blast-gate is controlled by a small electric motor geared to the gate shaft. In a centrifugal blower, the amount of power used by the motor bears a direct relation to the weight of air being delivered. Hence, assuming the voltage constant, the weight of air being delivered bears a direct ratio to the amperage consumed by the motor, and, because of this, the ampere reading may be calibrated in pounds of air per minute being delivered. By means of a simple device built into the ammeter, a predetermined amount of power can be delivered to the motor, hence, an equivalent weight of air delivered from the blower. This electrical apparatus will automatically control the position of the blast-gate to deliver this constant weight of air according to the setting on the ammeter. This control gives little trouble in practice.

Another automatic blast-gate air-weight control which operates mechanically has been thoroughly proved in practice. In this apparatus the gate which restricts the opening is mounted in the air pipe as described above. An orifice disc, similar to that used in flow-meters, is placed in the air pipe. Another mechanism is connected with small pipes which lead to the approach and delivery sides of the disc, and the differential pressure between these two pipes is registered in the instrument. This actuates other mechanical devices which in turn control the position of the blast-gate by means of compressed air. Here the principle of the flow-meter is used. Each velocity of the air through the orifice establishes a definite differential pressure. Therefore, the differential pressure may be predetermined for the amount of air flow required, and the instrument will automatically position the blast-gate to maintain that weight of air continuously.

In the case of steam-driven positive-displacement blowers the blower speed is usually controlled by hand. Air-weight controls are sometimes used to regulate the steam supplied to the engine, and in this manner automatic control is accomplished.

The type of control best suited for an installation is largely determined by the operating and labour conditions. Automatic control of the weight of air being delivered into the cupola is a valuable asset in some cases. This is particularly true where the melting supervision is not the best, or where the supervisor has other duties that consume most of his time. It also serves well when a predetermined rate of melting can be made in cases where the iron pouring operation can be more or less adjusted to melting rate of the cupola. In such cases the air-weight controller can hold the melting rate constant during the shift.

On the other hand, where the melting rate in the cupola must be constantly adjusted to meet varying shop needs, it is necessary for the supervision to make numerous adjustments even with the automatic air-weight controller. If these adjustments are necessary, a manually-operated controller would serve equally well if the installation is provided with flow-meters which would indicate the amount of air being delivered.

Where the positive-displacement blower is driven by a direct-current adjustable-speed motor, a simple tachometer may record the revolutions per minute of the blower. If the blower is kept in good maintenance, the r.p.m. indicator can be graduated into cubic feet of air per minute delivered at the normal operating pressure. Such an arrangement offers a very approximate meter for measuring air going into the cupola. The air slippage in a properly maintained positive-displacement blower does not vary greatly with reasonable variations in pressure. The volumes delivered at various pressures can be periodically checked by an ordinary flow-meter, and the speed indicator recalibrated when found necessary. Speed adjustments can be made by an ordinary rheostat manually operated.

By the use of various types of blowers and controls, sometimes claims are made of savings in coke, elimination of excess air in the cupola, fast melting, and a more uniform delivery of hot iron. The extent to which these claims are true depends entirely upon the conditions surrounding the operation that they are being compared with. It is easily possible to waste coke, to have excess air, to have a slow rate of melting with low-temperature iron, when using the most modern blowing equipment of any type if the cupola is not properly operated.

Noise and Vibration

The noise of operation of either type of blower, which is sometimes found objectionable, can readily be reduced at a minimum cost by properly-designed mufflers. This noise usually originates at the intake of the machine. Vibration, and hence noise, which is transmitted from the blower to the air piping, can readily be

* Paper presented at the sixth annual joint meeting of the Birmingham Sections of the American Society of Mechanical Engineers and American Foundrymen's Association. Mr. Moxley is assistant to the Vice-President, American Cast Iron Pipe Company, and Mr. Barr is one of his colleagues.

eliminated by the use of rubber connections at the intake and outlet of the blower. Also, this is splendid assurance that the blower will not be mounted under strain. Further reduction of vibration can be obtained by mounting the positive-displacement blower on shock-absorbing foundations.

Flexibility

Often, in the selection of blowers, future plant conditions must be considered. For instance, the size of the cupola might be changed, or the blast pressures might be radically different because of changed quantities of air required. In such cases the positive-displacement blower is very flexible, as such changes usually require changing of the speed of the blower only. Usually this can be done by changing the motor pulley or gear, and, at most, the motor. However, after such changes are made, the new conditions are efficiently and economically met.

If the new conditions require pressures beyond the pressure a centrifugal constant-speed machine was built for, the blower could not be used. If lower pressures were required, lower power economies would result. Changes in speed and hence top pressure can be made when a centrifugal blower is equipped with an indirect-drive adjustable-speed motor, or turbine drive. However, these types of drives are seldom used on centrifugal blowers.

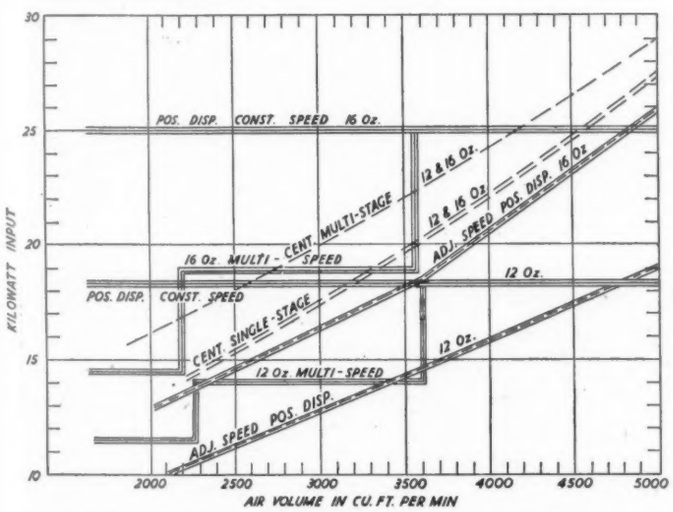

Fig. 1.—Characteristics of Cupola Blowers. All Values shown include Loss of Pressure across Orifice Plate or Blast Gates of Control Device.

Maintenance

Much has been said about the relative maintenance cost of the different types of blowers. A close study of the design of the two basic types of blowers would indicate a very much lower maintenance cost for the centrifugal. This is because there are usually only two bearings in the centrifugal blower, and they are anti-friction. There are no wearing parts in contact, and the whole construction is towards simplicity. If control units are used, they will probably constitute the major maintenance cost of the centrifugal blower. However, the same maintenance on control units will prevail when used on positive-displacement blowers.

It is well to bear in mind that, since there is no appreciable wear in the centrifugal blower, its efficiency and power consumption should remain constant throughout its normal life.

There are numerous installations of positive-displacement blowers showing an extremely low maintenance cost under very bad operating conditions. The new type of sleeve bearings and anti-friction bearings used on the modern positive-displacement blower greatly simplifies the alignment of the impellers, so that the life of the blowers should be greatly lengthened and the maintenance cost materially lowered. As an indication of long continuous service of the old-style positive-displacement blowers, the following list is interesting.

At the time these blowing units were dismantled, they were delivering air to melt approximately 300 tons of iron per shift. At the end of their period of usefulness, the maintenance was high, and the power loss due to worn impellers was estimated to exceed £300 per year.

Service Record of a Battery of Positive-Displacement Blowers.

Rated displacement. Cub. ft.	Rated pressure. Ozs.	Max. operating pressure. Ozs.	Built.	Age. Years.
45	24	35	1916	20
45	24	35	1918	18
45	24	35	1906	30
45	24	35	In service	over 20
51.2	24	35	1908	28

There are numerous cases where centrifugal blowers have given many years of uninterrupted service with practically no maintenance cost, with the original power economy maintained.

In the use of positive-displacement blowers, their life can be materially increased, and their maintenance lowered with resulting power saving, if more attention is given to providing clean air at the blower intake. Dirty air is an enemy to the positive-displacement blower. It has damaging effects in the form of abrasion to the centrifugal blower also.

In some quarters lower speeds are preferred in centrifugal blowers. To accomplish this, multi-stage machines have been developed. With the more accurate workmanship, anti-friction bearings, and dynamically-balanced impellers which are features of the high-speed (3,550 r.p.m.) modern machines, this high speed should not be objectionable.

Installation Cost

Too often the first cost of the blowers installed is taken as the determining factor, and sometimes there is confusion as to what is the true cost of the blowing equipment. The true cost of blowing equipment should include not only the cost of the blower and driving unit, but also such items as flow-meters, bye-pass valves, special motor controls, and extra cost for heavy platforms required for the positive-displacement type of blowers. The cost of a complete air-weight controlled centrifugal blower should not be compared with a manually-operated positive-displacement or centrifugal blower.

When properly compared it will usually be found that the positive-displacement system will be more expensive than a system using the centrifugal blower. The higher cost of a blower installation may or may not be justified by the metallurgical and operating conditions peculiar to the job. Many times the power required will show an economy on the higher cost installation.

Power

One of the most important factors in the selection of blowing equipment is power consumption. Once the cupola operation is set and the installation made, the power bill is a continuous and costly item. Since every melting job has its own peculiarities, a thorough study of power requirements under the actual operating conditions should be made.

As an example of the importance of this item, Fig. 1 is shown. A typical installation has been selected to illustrate the power characteristics of the various types of blowers. In this case it is first assumed that a maximum of 5,000 cub. ft. per min. is required at an average operating pressure of 16 oz. It is also assumed that the blowing equipment is purchased for a maximum pressure of 16 oz. In compiling these data the authors have sought the guaranteed performances from the various manufacturers. Where variations occurred, adjustments were made by the writers. All values are based on 60 deg. Fah. air and barometric pressure 14.7 lbs. per sq. in.

Referring to the top set of curves showing power input at 16 oz. pressure, it will be noted that slightly better economies are shown for positive-displacement blowers at 5,000 cub. ft. per min. delivery. At 4,500 cub. ft. per min. delivery there is practically no difference in power consumptions. When operating at reduced volumes, the constant-speed positive-displacement blower, bye-pass control, requires substantially more power.

In the case of positive-displacement blowers, further reduction in power can be made by the use of multi-speed motors while obtaining control of bye-passing. The curves shown in Fig. 1 indicate power consumption with a three-speed multi-speed a.c. motor. This type of

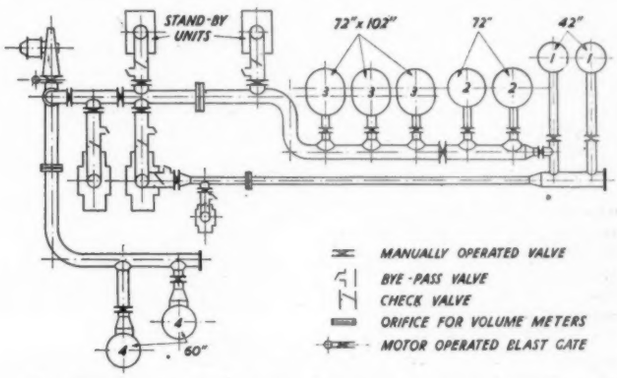

Fig. 2.—Lay-out of Blowing Plant at American Cast Pipe Company's Foundry. Operation 8 or 16 hrs. per day. Assume 2,000 hrs. per year. Assumed Operating Schedule:—

	No. 4.	No. 3.	No. 2.	No. 1.
80 per cent. of time—				
Cub. ft./min. ..	9,000	—	10,000	3,000
Ozs.	24	—	20	10
10 per cent. of time—				
Cub. ft./min. ..	—	18,000	—	3,000
Ozs.	—	35	—	5
10 per cent. of time—				
Cub. ft./min. ..	9,000	10,000	10,000	—
Ozs.	24	20	20	—

motor is more expensive and the controls more elaborate, although both have been thoroughly proved in practice.

Where foundries are under a kilowatt demand contract, the price per kilowatt hour is usually determined by the power factor of the entire plant, and a penalty is paid for low power factors. In using multi-speed alternating-current motors, a study should be made to ascertain what effect on the plant power factor such an installation would have. As an example of this, the following table shows typical characteristics of a 125 h.p. multi-speed motor. The characteristics of smaller motors would be more or less the same.

Load		600 r.p.m.	900 r.p.m.	1,200 r.p.m.
1/4	Efficiency ..	68	70	70
	Power factor ..	30	60	60
1/2	Efficiency ..	76	82	81
	Power factor ..	50	79	80
3/4	Efficiency ..	79	84	86
	Power factor ..	60	82	84
4/4	Efficiency ..	80	85	87
	Power factor ..	71	85	86

It will be noted that the centrifugal and the adjustable-speed driven positive-displacement blowers use power in almost direct proportion to the volumes delivered.

The positive-displacement blower driven by an adjustable-speed direct-current motor shows low power consumptions for all volumes. This condition can be obtained only when direct current is available. A good many foundries purchase alternating-current power, and to obtain this low power-input condition, it is necessary to convert alternating current to direct current with motor-generator sets or rotary converters. In this conversion, approximately 20 per cent. of the power is lost, and in such cases this additional amount would be charged to the blower.

In many instances the metallurgist and foundryman feel that a reserve pressure is needed for emergencies. In such cases the blower must be designed for a higher pressure than is normally used when delivering the same volumes. Such cases result in higher power consumptions when using centrifugal blowers.

As an example of this let us assume the same volume requirements as above at 12 oz. pressure, and that the blower must be capable of delivering these volumes at 16 oz. in emergencies. Power consumptions for the centrifugal blowers would remain as shown by the top set of curves in Fig. 1, while a material reduction of power is shown by the lower set of curves for the positive-displacement type.

To illustrate the difference in cost of power under the conditions assumed above, and based on 200 four-hr. operating days per year, with the cost of power at ¾d. per kilowatt-hr., Table I is given. A study of this table will show the relative costs of power under the various operating conditions. All cost savings shown are compared with power cost of constant-speed positive-displacement blower controlled by bye-passing.

TABLE I.—*Comparative Yearly Power Costs.*

(16-ozs. blowers when operated at 16 ozs. and 12 ozs.

800 hrs. per year—Power cost at ¾d. per kw.-hr.)

Type of blower.	16 ozs.-5,000 cub. ft./mm.		16 ozs.-2,500 cub. ft./mm.		12 ozs.-5,000 cub. ft./mm.		12 ozs.-2,500 cub. ft./mm.	
	Cost.	Saving.	Cost.	Saving.	Cost.	Saving.	Cost.	Saving.
Constant speed .. .. Pos.-disp. Bye-pass.	£60	Nil	£60	Nil	£44 12s.	Nil	£44 12s.	Nil
Multi-speed .. .. Pos.-disp. Bye-pass.	£60	Nil	£45 12s.	£12 8s.	£44 12s.	Nil	£34 8s.	£10 4s.
Adj.-speed .. .. .. Pos.-disp. Hand control.	£62 8s.	* £1 8s.	£36	£24	£45 12s.	*£1	£26 8s.	£18 4s.
†Adj.-speed .. .. Pos.-disp. Hand control.	£78	*£18	£45	£15	£57	*£12 8s.	£33	£11 12s.
Cent. .. .. .. Single-stage. Auto. control.	£66	*£6	£37 4s.	£22 16s.	£66	*£21 8s.	£37 4s.	£7 8s.
Cent. .. .. .. Multi-stage. Auto. control.	£69 12s.	*£9 12s.	£43 4s.	£16 16s.	£69 12s.	*£25	£43 4s.	£1 8s.

* These values represent losses instead of savings. † 25 per cent. power added for conversion from a.c. to d.c.

In plants where steam is available, the cost of steam is dependent entirely upon the local conditions. For this reason the costs of power of the turbine-driven centrifugal and the engine-driven positive-displacement blowers have been omitted.

Fig. 2 shows the schematic layout of a blowing equipment recently installed at the American Cast Iron Pipe Company, Birmingham, Alabama. The various operating conditions are also shown. It will be noted that wide variations in pressures and volumes are required, and in some cases two blowers are required to serve one cupola.

The foundry operation is continuous and spares for all blowers were required. Two positive-displacement blowers driven by multi-speed motors and one small blower direct connected to an adjustable-speed motor were installed. Also a single-stage centrifugal blower of the old melting plant was used. Two old positive-displacement blowers were also used as stand-by units.

The blowers are installed some distance from the cupolas and have remote control. All control is from a control-board in front of the cupolas. Also mounted on the control-board are blast-pressure and volume indicators, and indicators showing the temperature of the hot blast. All of these motors are of the recording type.

Conclusion

A thorough analysis of the metallurgical and operating conditions should first be made. Maximum pressures and volumes should be clearly established at the beginning. Next, the average pressure and volume conditions should be studied and assumptions made, arriving at what proportion of the operating time the various pressures and volumes will be required. These pressures should include pressure losses in air ducts, valves, bustle pipes, etc.

To meet these conditions, the best combination using each type of blower should be considered for capacity, pressure, control, etc. With this information in hand, the yearly power cost can be calculated. The selection of a particular type of equipment can then be considered based on the installation cost, and the yearly power consumed.

Such questions as maintenance, flexibility, adaptability to possible future plant changes, space requirements, and noise are largely local matters, and depend entirely upon the local requirements.

FIG. 3.—VIEW OF AMERICAN CAST IRON PIPE COMPANY'S INSTALLATION OF THREE POSITIVE-DISPLACEMENT BLOWERS.

Two blowers at left are driven by 4-speed, multi-speed motors connected by V-belt drive. Capacity 10,000 cub ft./min. at 35 oz. pressure. Motor speeds 1,200, 900, 600 and 450 r.p.m. each. Note rubber connections at outlet of piping and motor-operated bye-pass valves, also automatic check valves at all outlets returning from blower.

It is thought that every cupola blowing job has its pecularities and is different from all others. Therefore, there is no particular type of equipment that is best suited for all jobs, but each type has distinctive advantages under some conditions. It is for the engineer and foundryman to analyse methodically the job requirements, and then to select the type of blower which will best fit those needs.

Moulding Aluminium Cooking Pans

BY WILLIAM GUDGEON.

When moulding aluminium cooking pans, the important thing to be kept in mind is that the inside of the casting must machine up perfectly clean. Sand holes, pitted surface, or blemishes of any kind common in the casting of aluminium, must not show inside the pan, because cooked food is apt to lodge in the cavities and is difficult to remove in the process of cleaning; the result is the lodging of decayed matter which would soon turn the food sour.

The writer used a fine yellow loam sand, though not too close to prevent the escape of air and gases when the molten metal contacts with the sand.

Gating

The first operation to receive attention was the gating of the mould. As will be seen from Fig. 1, the thickness of the metal is only ¼ in., and there was some doubt as to whether, if gated at the bottom, the metal would chill before reaching the top of the mould. Although the rule in gating aluminium moulds is to ensure that the metal enters the mould at the lowest point so as to prevent any agitation of metal in the process of pouring, the method of running the aluminium in from the top of the mould was tried with complete success.

A three-part aluminium box was used which made it easy for one man to handle. The drag was levelled on the floor and remained a fixture until the order was completed. This was rammed solid with sand and strickled off level with the box edge. At this stage a few vents were pushed right down through the centre. Aluminium chills of about 1 in. thickness, of which four were used to complete the circle, were placed in the pattern where the ¼-in. filleted section occurs. These chills prevent spongy places at the point where the gates are cut off.

Sand is then sieved inside the pattern to half its depth, and rammed lightly with the spade handle. The remaining half is then filled, rammed lightly as before and strickled off level. A handful of sand is then scooped out of the centre and the cavity well vented sideways and downwards with a ¼-in. wire. The hollowed-out centre will take care of the gases evolved.

The pattern is next gently turned over on to the bottom part, rapping it lightly with a wooden mallet so as to give it a firm impression on the underside. The joint is then made and the middle part of the box placed in position. This is then rammed tightly with sand, and, when about 1 in. from the top of the pattern, the sand is well vented down to the bottom joint. The rest of the sand is filled, the joint made and the top is put on and rammed up. Before lifting off, the top vents are brought from underneath the drag.

Running Methods

A channel is cut all round the pattern, but not connected with the riser, which is at the opposite side of the down runner. From this channel, twelve spray ingates are cut about the thickness of a shilling and 1 in. wide. The middle part is carefully lifted and turned over, the pattern (which is of aluminium) coming with it. The pattern is then withdrawn, any loose sand made firm and the mould closed. No water must be used on the mould, as a local agitation would be set up when the molten metal contacts the moisture. The sand should be worked as dry as possible.

As the writer had no pyrometer, the metal was poured at a blood-red heat and an aluminium alloy of 5 per cent. silicon was used. A cast-iron ladle was used to melt the aluminium, care being taken when pouring to keep the ladle as low as possible so the stream of metal would fill the bush quietly. It is important, once pouring has started, that the bush be kept full until the metal makes its appearance in the riser, which is left open for the escape of air.

Nearly two hundred castings of this type were made, and the finished articles have withstood all the tests demanded of them.

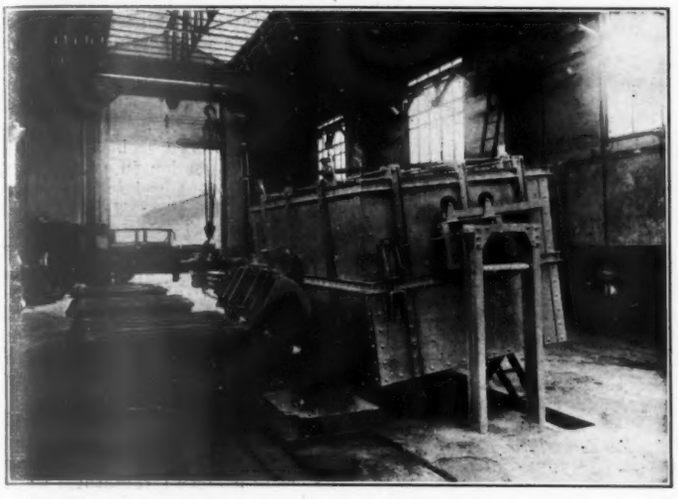

FIG. 1.—2-TON OIL-FIRED COPPER-MELTING FURNACE BY PENICUD & COMPANY.

FIG. 1.—GATING ARRANGEMENT FOR CAST ALUMINIUM COOKING PAN.

A French Copper-Melting Furnace

The Société Alsacienne de Construction Mécaniques, a well-known French engineering works, have recently installed at their Clichy works a 2-ton capacity copper-melting furnace of unique design. The whole of the plant, including the furnace and ingotting arrangements, were designed and manufactured at the works of Penicud & Company, of Bagnolet. This firm's products, by the way, are now being manufactured in England by the Thermic Equipment & Engineering Company, Limited, of Foundry Yard, Salmon Street, Preston (Lancs). The furnace is oil-fired in such a manner as to allow of oxidising conditions for the removal of the sulphur or to permit of a reducing atmosphere for finishing. As is shown in Fig. 2, the roof is removable for facilitating repairs to the hearth. This roof is constructed by the Arcopen method and is stated to last about 450 heats.

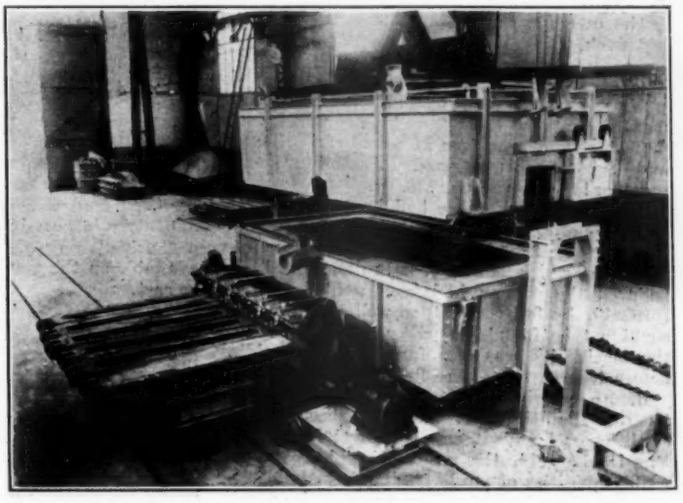

FIG. 2.—FURNACE WITH ROOF IN RAISED POSITION.

The design, as is obvious from our illustrations, is such as to give a maximum of accessibility to the oil-burning equipment, the poling and charging doors, the spout and the mechanism generally. Special consideration has been given to the level of the doors for charging and poling. The furnace is electrically tilted to fill a specially designed ladle. This ladle, again lined with Arcopen refractory, also is electrically tilted and simultaneously fills six pig moulds. These moulds are mounted on a wheeled bogie, which obviously makes for a quick disposal of the metal. The bogie is provided with ball-bearings, and the six pig moulds are all dressed with a special brand of colloidal graphite—a measure which effectually prevents spitting and produces a good surface on the ingot. The moulds weigh 275 lbs. each and take 135 lbs. of copper.

The furnace makes a nice compact job, as it is only 10 ft. long by 5 ft. wide, and is 6 ft. high. The charging and poling door sills are 3 ft. from ground level. The whole structure weighs about 10 tons without charge.

Swansea's New Engineering Factory

Details made public regarding the Government's engineering factory at Landore, Swansea, which is to be operated by I.C.I. Metals, Limited, and is nearing completion, show that it will provide employment for 1,200 men on a two shifts per day basis. The site comprises an area of nearly eight acres. The floor area of the factory buildings is about five acres.

Iron Castings *versus* Steel Fabrications

THE MOCK TRIAL CONTINUED

Last week we referred to the mock trial (arranged by the London Branch of the Institute of British Foundrymen and the Institute of Welding, and held in London as a joint meeting) in which "Lord Ian Castings of Ferrous Court" applied for an injunction against "Steel Fabrication, Esq., of New Terrain," the terms of the action being set out in our last issue. The President of the Court was Mr. W. Tudor Davies, B.A., Barrister-at-Law, F.R.Econ.S. Mr. R. B. Templeton acted as Counsel for the Plaintiff, and Mr. A. Kershaw as Counsel for the Defendant.

The case for the Plaintiff was fully reported last week.

THE CASE FOR THE DEFENDANT

MR. A. KERSHAW, opening his case, commented that the term "welding" was used in many walks of life; even Members of Parliament and high officials referred to welding peoples together!

Inasmuch as reference had been made to the antiquity of casting, he pointed out that in India there was the Delhi column of almost pure iron, the age of which had never been determined. He believed the column had been welded together (probably by fire welding) so well that the joint could not be found. Further, he believed that the blacksmith was also familiar with welding before iron castings were first used.

Before replying to the detailed points raised by the Plaintiff, Mr. Kershaw discussed the qualities and advantages of a steel fabrication. Firstly, he said, the material might be either wholly qualities of steel ranging from mild steel of approximately 28 to 30 tons per sq. in. tensile to high-tensile steel of 45 to 50 tons per sq. in. tensile strength, or each, or any part of the fabrication might be made of a quality of steel (either rolled or cast) according to the work or duty to which it was assigned.

Composite Structures

It was convenient, for instance, to use mild steel for the base of a machine structure, to use a high-tensile steel for such parts as were subjected to high tensile stresses, to use a work-hardening steel or a steel with high resistance to wear for parts subjected to abrasion or friction, and to combine in the same one-piece design cast-iron or cast-steel bearing pedestals or similar parts which would prove uneconomical if made a fabricated basis. That feature of combination of the wide variety of steels now available enabled not only superior design qualities to be evolved, but in many cases it also made possible a saving in weight, a reduction in size, or an increase in strength.

Even at the present time, when the use of several grades of steel in any one fabrication was not general, it had proved economical in some cases, and in others advantageous because of the increased strength available, to build fabrications which were 50 per cent. of the weight required of similar structures in cast iron, and which had a greater resistance to fracture when subjected to overloads.

Cutting Torch as Auxiliary

The material had also the advantage of being suitable for cutting into very complicated shapes by means of the oxy-acetylene cutting torch. Further, the material was approximately equal in strength in either tension or compression, and was capable of sustaining impact and shock without fracture.

For those reasons, each part of the fabrication could be designed economically for the duty, and one part might be 2 in. or more in thickness and yet be connected adequately to a part only $\frac{1}{4}$ in. thick. That fact was of the utmost importance, as in a casting all the sections connected together required to have almost similar section or thickness, in order to prevent fractures or porous draws, or to remove casting difficulties.

Those features of high tensile strength and uniformity of material (to a British Standard Specification), coupled with an economical price, gave the designer a medium which offered no restrictions to fundamental design other than a knowledge of how to arrange the parts for welding and a knowledge of the strength of the weld indicated as necessary to withstand the load imposed.

The PRESIDENT asked whether Mr. Kershaw was referring to an "economic" or an "economical" price, for there was a difference.

MR. KERSHAW replied that both were applicable; but he certainly included an economical, *i.e.*, a low, price.

The material and welds, he continued, could be disposed in the best possible manner to meet the designed load without any consideration of the difficulties of casting, the requirements of the patternmaker or of the quality of the cast iron available on the particular day the article would be cast.

Cost Comparisons

Coming to costs specifically, he gave the following figures for actual jobs carried out in mild steel, excluding from the casting costs any cost of design, pattern or machining, and excluding design and machining costs from the fabrications, and said that they spoke for themselves on the grounds of economy alone:—

Weight.		Cost.	
Cast. Lbs.	Welded. Lbs.	Cast. £	Welded. £
29,470	21,300	567	380
36,000	17,790	435	221
15,620	10,100	248	170
6,124	3,700	109	77
5,576	1,920	64	22
4,980	3,000	70	47
2,600	1,600	37	26
820	550	18	12
210	140	2	1.7

A point in that comparison which was worth stressing, he said, was that the jobs were actually costed. Instead of taking a casting at so much per ton on an average basis, accurate costing was applied, which made a direct comparison possible. It was not claimed that the steel fabrication was superior to the casting in every case. Some structures of a simple type, or small structures requiring large quantities from the same pattern, were definitely better as castings, and showed some saving in cost, whilst also they might have a better appearance.

Since the art of welding became a production method, industry had found a definite field in which the steel fabrication showed better results and economy in cost, and a further field was becoming evident in a combination of fabrications and castings, which enabled the best features of both methods to be available at an economic cost.

Curves No Criterion

Dealing with the suggestion that a steel fabrication was ugly and had few, if any, of the curves now evident in castings, he said that appearance alone was no criterion; and, if it were permissible to mention it in the Court, the outline of the feminine form had changed alternately from curves to straight, and back to curves, and had still found appreciation! The modern tendency in architecture also was to produce clean lines of rectangular shapes, built together in proportions which gave a pleasing and satisfying appearance. There were critics of that style, too—usually they had very old-fashioned views and were very much behind the times. Curves were also possible in steel fabrication; but, as in other things, curves were expensive. As steel fabrication progressed, the necessary plant would be installed by industry to enable bending, folding and pressing to be carried out economically. Where that had already been done, steel fabrications had been produced with curves and appearance equal, if not superior, to those possible at economic prices in a casting.

Contraction and Distortion

Discussing contraction and distortion, he said that much had been made of the dangers and difficulties due to the locked-up stresses and distortion often attributed to steel fabrications. The Papers read by various engineers who were familiar with the problem, and who had given of their experience to enable those difficulties to be faced and removed, had often been pointed to as evidence of the danger of using steel fabrications for certain classes of work. He suggested that welding engineers who had discussed locked-up stresses and distortion in public as a problem to be solved by the welding engineer were only being just as honest as Mr. E. Longden (a member of the Institute of British Foundrymen) in his Paper on "Contraction and Distortion in Grey Cast Iron," presented to the Scottish Branch of his Institute on January 15, 1938. Mr. Longden had revealed some astonishing values of contraction in large castings—not castings as a whole, but in different parts of a casting—and had pleaded for balanced design for castings.

Mr. Kershaw added that he personally had seen the patterns of long beds rammed into the sand with a camber of many more inches than would be necessary to achieve straightness when cold in a steel fabrication of the same size. Therefore, he suggested that the distortion and locked-up stresses in a steel fabrication (most of which stresses disappeared in 24 hours) presented no greater problem than those present in the products of the foundry or any other form of engineering, and that experience and research were in fact reducing those factors to an almost negligible position in the production of fabrications.

Compositional Control

Coming to a discussion of cast iron, he said that any one melt from a cupola must necessarily be of the same composition, so that all the castings made from that melt, large or small, must be of the same material. But the influence of the metal composition was great, so that a metal suitable for a large casting was quite unsuitable for a small one. That necessitated either the use of several cupolas with different melts or the grading of castings to suit the melt. Thus, a foundry dealing with general work and having only one cupola had of necessity to cast large castings from the same melt as the small castings.

He believed it was usual to add alloying metals in the ladles, to assess the pouring temperature by experience, and that it was common to pour large castings with two ladles, which might be at different temperatures; he believed also that it was possible to adopt different procedures in pouring. Thus, there were far more variables in casting than in any ordinary type of fabrication.

As to design, he said that when a casting was designed—presumably by a designer who was familiar with casting procedure—in nearly every case the design was altered by the patternmaker and also by the moulder because of difficulties. There were well-known cases where castings, which of necessity required to have heavy bosses or thick parts, had had to have a heavy section throughout, in order that they might be cast successfully. Give a pattern of any large size to one moulder at one time, and

to another moulder at another time, and there were inevitable discrepancies in finished weight, seldom less than 10 per cent.

In the case of a long bed with bosses, when the bosses were bored out to receive the bearing bushes one usually found a very large amount of open coring and porous work, so that the bosses had to be bored out larger and steel linings fitted.

Machining Allowances

The patternmaker made an allowance for contraction and machining; more often than not, that was the cause of friction between pattern-shop and foundry, and the moulder or foundry manager adjusted the machining allowance to be on the safe side. That was particularly evident on long castings which had to be machined the full length.

Owing to those discrepancies in weight, machining allowance, Brinell hardness and quality of cast iron, a complicated machine-shop procedure was in use, in order to overcome such difficulties. For castings in which it was necessary to have a certain amount of machining allowance, the whole tendency of shop experience over the last 20 or 30 years had been designed to minimise those faults; we were so accustomed to them that we regarded them as an essential part of casting production. Those experienced in welding realised how much time had been wasted during the last 30 years in trying to correct mistakes in castings.

In clarifying the problem, it was necessary to appreciate that the majority of the faults lay within certain boundaries. The general non-repetition casting, weighing between 15 cwts. and 20 tons, which was cast in the general foundry, was the chief offender. It should be recorded that the comparatively small repetition casting had reached a high standard against which there was little complaint.

From the evidence it was obvious that there was a field for the casting and for the welding, and that concentration on the individual fields would enable the economic tonnage of each method to be increased. Fabrications were being made which could never have been designed without welding; similarly, castings of high quality were available, of their own type, which could never be replaced by welding. In every walk of life, the fabrication made by welding was making steady progress. The very vehicles which had transported those attending the Court were welded in some part or other; in fact, it was difficult to find any ferrous or non-ferrous industry in which welding was not accepted as sound engineering practice.

Perhaps some little part of the usage of welding might be attributable to high-pressure salesmanship; but the highly economic factors which governed industry precluded the use of any method which was uneconomic in the engineering field, and the high standards of safety imposed on any structure for public use prevented the use of unsafe methods, however economical they might be.

Markets for Castings and Weldings

As to markets, he said that even after the foundry industry had lost the cast-iron beams and stanchions to the rolled-steel section, the industry had still increased its markets. It was probable that the total tonnage of both castings and weldings had become greater than was ever turned out by castings alone; an increased trade and prosperity would produce a still greater tonnage of castings than had ever been made. The problem was one of sound engineering principles—to use a casting when a casting was best, and a steel fabrication when a fabrication was best. Many of the problems in casting and welding were similar, and he suggested that the foundry could gain from the manufacture of both castings and steel fabrications and could thus satisfy a greater market than ever before with both types.

Finally, he said that the Defendant was willing to co-operate in that joint market. The design staffs of many of our great industrial firms used the casting or the steel fabrication at the dictates of engineering principles. The sole measure of such a distinction was the application of sound engineering principles in the economic production of finished goods, in which the customer always had the last word. If the customer found that a welding had let him down, he would buy no more; but the reverse also applied, and the steel fabrication industry was content to await the verdict of the court of economy and industry.

Replying to a question by the jury as to where the stresses in a fabricated structure disappeared to, Counsel suggested that they disappeared in the same way as the stresses from a piece of elastic. That reply brought the suggestion from someone in the public part of the Court that, therefore, fabricated structures were not rigid.

EVIDENCE FOR THE DEFENDANT

MR. T. A. SWINDELL was the first witness for the defence. He said he had had many years' experience in the manufacture of fabrications, with well-known firms, and was still connected with the welding industry. The weights and costs of castings and steel fabrications, given by Mr. Kershaw, were reasonably accurate and indicated some of the savings possible by using steel fabrications. From practical experience one might accept that, when replacing iron castings by welded steel fabrications, of equal strength, there would be a saving in weight of 50 per cent., and a saving in price of 50 per cent., *i.e.*, the cost of the fabrication would be two-thirds the cost of the casting.

Asked how the use of a steel fabrication helped in design, he said it helped in a number of obvious directions. There was reduction of weight, of course, and increase of strength for the same dimension as a casting. Fabrications might be made with materials of varying analysis; for example, one might have a mild-steel frame with wear-resisting inserts of high-tensile steel. By adopting fabrication, one might also reduce machining allowances very considerably. The electrical engineer, of course, adopted steel fabrication for his parts because of the much improved magnetic permeability of steel. Machining time was reduced, as well as delivery time, in the case of the fabrication as compared with the casting.

MR. KERSHAW asked if the steel used for fabrications was easy to cut into complicated parts such as would be difficult to cast or costly to forge; for example, long, narrow and thin structures would be difficult to cast.

MR. SWINDELL agreed, and said that in fabrication, by welding, one could connect light sections to heavy sections. The smith's work might be reduced very considerably.

Asked what was the weight of the largest fabrication of which he had had experience, he said it was 27 tons, and he had delivered it within eight weeks from the time of receiving the order.

MR. KERSHAW: Without the need for patterns, and without the need for any ageing or putting it out in a field to be exposed to frost and snow, you delivered it in eight weeks?

MR. SWINDELL agreed.

Cross-Examination of Mr. Swindell

Cross-examined by Mr. R. B. Templeton (Counsel for Plaintiff), witness said that he had not been engaged as a foundry manager or other foundry executive or estimator, although he had selected labour for foundries.

MR. TEMPLETON, referring to Mr. Kershaw's comparative cost and weight figures for castings and welded fabrications, said that the first casting mentioned weighed about 13½ tons, and he asked what would be a fair price per ton or per cwt. for that casting in iron.

MR. SWINDELL replied that a fabrication of that weight would cost about £26 per ton. A steel casting might cost £30 per ton, and an iron casting might cost something less than £20 per ton; but, of course, to be of equivalent strength it would have to be probably twice the weight.

MR. TEMPLETON said there seemed some discrepancy between the cost figures given. But the 13½-ton casting cost £567, which worked out at £44 6s. per ton, and he asked if that were a high price per ton for a casting of that total weight, an ordinary iron casting.

MR. SWINDELL agreed that for an ordinary iron casting it would be a high price. But he believed the particular casting mentioned was quite a complicated electrical alternator stator frame, and the price might very well be as stated. It was not an ordinary casting.

MR. TEMPLETON referred to another casting in the list, weighing 820 lbs., and costing £18. He asked if that also were an exceptional casting; the cost worked out at £56 per ton, and he wondered how many foundrymen would like to make castings at £56 per ton.

MR. SWINDELL said he did not know the nature of that particular casting.

MR. KERSHAW said he had emphasised that each item in the list was costed separately, and included the overhead costs, which often were not very easily ascertainable by the ordinary method of arriving at a figure per ton on an average basis.

MR. TEMPLETON submitted that the figures were most misleading.

THE PRESIDENT said the jury wanted to know where witness bought steel castings at £30 per ton.

MR. SWINDELL replied that he had bought steel castings at £24 per ton in 1933, and he understood that the cost of those castings had increased by 25 per cent. They could be bought at Middlesbrough.

Replying to a question by Mr. Templeton as to the number of welders employed in the production of the 27-ton fabricated structure which he had mentioned as the largest of which he had had experience, and as to whether they were of uniform ability, he said he believed that eight were employed on the work and their ability was as nearly uniform as one might expect to find. They were all trained by the same system.

In reply to the President's query as to what that system was, he said it was founded on the practice of a number of firms, including Metropolitan-Vickers, of Manchester, the American Westinghouse Company, and the G.E.C. of America.

THE PRESIDENT asked if there was much expense on jigs or assembly tackle when erecting the 27-ton structure.

MR. SWINDELL replied that there was not, and that that feature was an advantage of welding. The pieces were cut to form and welded, and there were no expensive jigs in making that particular structure.

Complying with Specifications

MR. L. A. FERNEY, who said he had been apprenticed in the foundry for a time, gave evidence on the present position of steel fabrication in relation to castings. Asked whether in his opinion the materials available for steel fabrication were reliable and consistent to specification, he said they were if they were bought to specifications; but not everyone bought steel to specification.

Asked if the steels that were bought to specifications conformed to the specifications within the limits imposed, he said the firms with which he had been associated tested the steels, which had never failed to comply with the British Standard Specifications. It appeared that the steels were manufactured under laboratory and metallurgical control, judging by the results.

Replying to the President as to whether the specifications allowed a tolerance, he said they

did; 28 to 30 tons was the usual specification for mild steel.

Asked by Mr. Kershaw whether similar methods of control were employed in the manufacture of electrodes, he said he imagined that the methods used in steelworks were far less stringent than those employed by electrode manufacturers. The properties were consistent to within 0.01 per cent.

Questioned on the tests applied in the manufacture of electrodes to comply with specifications, and the tests to evaluate the metal deposited from a standard electrode, he said the material used in the manufacture of the electrodes was tested, mainly analysed. As to the weld metal itself, it was usual to make a complete test for approximately every ton manufactured. That usually covered the B.S.S. 636, Lloyd's and the Board of Trade.

Replying to questions by the President as to whether the specifications were up to date, he said they were dated 1935 or 1936; there was a later one for structural steel, but he did not know whether there was another for ship work. The specifications did not differ to any large extent.

MR. KERSHAW asked if cast iron was produced to anything like the same accurate and close specification regarding composition and properties as were steel and electrodes.

MR. FERNEY replied that the firm with which he was associated had recently had 100,000 Izod tests made, and bending tests had been carried out on a similar scale. On the other hand, in a large iron foundry he knew he had seen very little metallurgical work done. It was the practice of a Scottish foreman there to put something into the ladle before the metal was poured.

Cross-Examination of Mr. Ferney

Cross-examined by Mr. Templeton, who said that witness must have served his apprenticeship in the foundry some years ago, he said he had spent part of his time in the foundry, about 1926. When it was suggested that he had not had much experience of the type of material now being produced in the foundry, he replied that the firm with which he was apprenticed had not expanded its foundry activities to any extent, but had installed a very large fabricating department.

MR. TEMPLETON asked if witness would use the same type of electrode for welding a high-nickel steel, an oil-hardening steel, as for a mild steel.

MR. FERNEY said that that would depend on the carbon content of the nickel steel.

MR. TEMPLETON suggested that an inexpert welder might make a mistake in regard to the type of electrode he used.

MR. FERNEY replied that there were nickel steels which presented absolutely no difficulties and could be welded with mild steel electrode; but others could hardly be welded at all.

The PRESIDENT asked if witness suggested that he had never had a defective test-piece either from a casting or a weld.

MR. FERNEY said he had spoken of neither; it was a question of the raw material supplied. Obviously, a reputable firm supplying steel was bound to supply practically always a steel of at least 28 tons tensile (that was the minimum specified), and there were very few cases where that failed.

Common Faults Outlined

MR. E. B. SHORE, the final witness, who was asked by Mr. Kershaw to describe some common faults in foundry castings such as were capable of replacement by steel fabrication, said the most common fault was that of inherent stress set up by shrinkage during cooling; and if the casting were composed of sections varying much in thickness, irregularity of grain size would occur, due to differences in rate of cooling, owing to varying densities of metal. Another fault which in many cases was not considered was where covers were secured by setscrews, holes for which were tapped into bosses or thickened portions, and the metal, being of open grain, reacted to wear quickly, with the result that holes had to be tapped larger and over-size screws fitted. Again, in large castings there was the fault of cold runs—and that was where the welder got the moulder out of a difficulty. None of those troubles occurred in fabrications, for the metal used was of uniform density in plates of varying thickness. Another problem which entered into the production of castings was that of the human element. It seemed to him that the human element was an important factor in the closing of the box, owing to varying thicknesses in the casting, which should be uniform, but were not.

Asked for his opinion with regard to patterns for large castings, he said one might answer by asking for a reply, "yes" or "no," to the question "Do you still beat your wife?" Large patterns were costly to make, and if a considerable time elapsed between usage there was always the expense and trouble of repairs, owing to deformation—shrinkage or otherwise—due to storage. When the moulder received the pattern there was sagging; sometimes it had to be cut into two, sometimes into three. He had seen one for a casting of only 3¾ tons recently, and it would have needed four boxes to cast it. In his experience, large patterns were very bad indeed; they represented a poor method when one contrasted casting and fabrication.

The JURY asked if there was not a period of cooling for both castings and welded structures.

MR. SHORE replied that there was, and in that period the cracks, fractures and such like occurred in a casting. On the other hand, in a weld during that period there was a normalising of the weld. Where there was a series of, say, five or six runs, the bottom five of the six became normalised and lost the distortion that had been mentioned.

MR. TEMPLETON did not cross-examine, on the ground that the witness was much too "tough" for him. (Laughter.)

SUMMING-UP BY COUNSEL

MR. KERSHAW, summing up on behalf of the Defendant, said he had no complaint against Counsel for the Plaintiff in regard to the statement that the Egyptians in the time of Homer were familiar with the manufacture of iron. He suggested that it was only when the iron was perverted to the cast variety that the trouble was introduced. The art of welding was also in use even at that period, since blacksmiths' fire welds had been found in the very early stages of craftsmanship.

Nor had the fact that the modern welding industry was definitely under scientific control, and with modern research methods, been misstated; it was the claim that the foundry was also under such control that was disputed.

It was also disputed that high-duty and alloy cast irons were in everyday use, or were available from any except a few specialised foundries—and those applications were in very few cases in competition with fabrications. Such high-duty irons and alloy cast irons had also an increased cost, which enabled even greater economies to be shown by a steel fabrication (in cost per ton).

Ease of Welding High-Duty Irons

Dealing with the reference to the caution of certain Government Departments in connection with the welding of cast iron for repairs, he said that perhaps Counsel for the Plaintiff would also agree that the specification calling for machines to be made of "sound grey iron castings which have been suitably aged for a period (of two months) between casting and machining" would indicate distrust of castings which had not settled down or got rid of their internal stresses for that period. Most foundries, instead of going properly into the question of welding repairs, hid such repairs in some obscure corner, with little or no consideration of the difficulties presented by the material. It was a remarkable fact that the high-duty irons were much easier to weld than were the graphitic cast irons, which still represented 80 per cent. of the castings used in the heavier section of the industry. In other words, the nearer cast iron was to bad steel in composition and physical properties, the easier it was to weld.

As to the complaint by the Plaintiff that welding salesmen compared the tensile properties of welded structures with those of low-grade cast iron, he said that equally the Defendant could complain that the Plaintiff had compared his high-duty cast iron with a low-grade electrode.

Locked-up Stresses

He was unable to agree that even the enlightened foundrymen (*sic*) could control the composition, structure and cooling range of a large casting, especially one with intricate coring, which was poured from two ladles and could not be designed as a balanced casting. Such a casting could produce a range of internal stresses, Brinell hardnesses and tensile strengths which would only be equalled by the variety of the cast irons found in the various parts of the castings.

If one side of a casting were machined, internal stresses were released, as in any other metallurgical product. In fact, there was very little difference in the phenomena in either a casting or a welding due to locked-up stresses. The welding had the advantage that the material could accommodate itself to such stresses without fracture at any time, whilst those in the casting produced porous draws during the plastic cooling period, which might appear as cracks many months after the casting had been put into service.

It was only necessary to use the same precautions in machining a fabrication as it was in a casting to obtain the same permanence of structure if the fabrication had been designed to the same limits as the casting. If the two were of equal weight, the deflection or inaccuracy in use could be limited to half that of the casting.

The class of workmanship in modern weldings was no worse than that of the casting produced from so many barrowfuls of scrap (of unknown composition), pig and coke, cast at a temperature judged by the eye, and perhaps knocked out of the flask before it was cooled to the correct point because the flask was required for another job.

Superior British Practice

Much of the evidence instanced by Plaintiff came from America and, in these days of rapid improvement by research, was rather old; one reference was 1931, another 1933, and so on, and it was time that the Plaintiff added to his library! The Government Departments had published test figures which were conservatively British, our largest surveying companies had done the same, and the London County Council had approved a code for welding. Any one of those codes would refute the figures quoted by the Plaintiff, and it was generally admitted that the standards of welding set up in this country were much higher than those in use elsewhere, due to the general use of high-quality covered electrodes, whilst other countries had gone through the phase of bare-wire welding.

In regard to corrosion, he need only mention the large use of stainless and copper-bearing steels now available.

Reference had been made to the capacity of cast iron to withstand compressive stresses. But surely the fact that machines had been designed for so many years to defeat the weakness of cast iron in tension was no reason why the correct principles of design in the use of a material which had a high tensile strength should be perverted?

He instanced a common type of hydraulic press, and said that such a machine made of cast-

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W.33R

ings was a façade of cast iron masking the true strength of the press contained in the steel tie-bars which took all the stress. A modern fabricated steel press frame took the stress in its side members without difficulty, and enabled a great reduction to be effected in weight, space and cost.

In conclusion, he said the Defendant sought only to ensure that British industry took full advantage of every tool and production method available in its struggle for supremacy, and any preference shown for materials or methods which had not kept up with progress could only hinder. He suggested that, owing to the competition of the Defendant, the noble Lord had shown an activity which his hoary ancestry would belie, and was thus indebted to the Defendant for a new lease of life which could only be compared to glandular treatment! They had a mutual friend and acquaintance in the Hon. Percy Nickel, who tried at times to run with the hare and hunt with the hounds, but who, on the whole, managed to maintain friendship with both parties. Counsel offered the Defendant's help in repairing the noble Lord's castings and in obtaining an even larger market in the combined sales of castings and fabrications similar to that available in the country from which Counsel for the Plaintiff had produced so many references.

PLAINTIFF'S CASE

MR. TEMPLETON, summing up on behalf of the Plaintiff, said it was well known that the expression "a household word" meant something that defied contradiction; and he emphasised that "Strong as Cast Iron" was a household word or term.

Emphasising briefly the outstanding points produced by the evidence, he said they were:

(1) If engineers and designers would only take the founder more into their confidence he would be able to show them how to improve the properties and lighten the design of their castings.

(2) The engineer could with confidence order castings to B.S.S. 786 and know that he would get a material with definite physical properties and one on which he could rely.

(3) Cast irons conforming to B.S.S. 786 were better under compression stresses than was steel.

(4) Cast iron had better wear and corrosion-resisting properties than had steel.

(5) Cast iron had a higher damping capacity and would reduce vibration and noise more than would steel.

(6) Cast iron was less sensitive to notch effect, and, therefore, relatively better in fatigue strength.

An interesting fact was that in cutting up steel rails for scrap purposes it was only necessary to notch them with an oxy-acetylene flame and let them stand overnight. Next morning they could be broken by a light tap. That was not a criticism of the steel, for that easy fracture was due entirely to the action of the flame, which created brittleness and started a crack at the bottom of the cut.

Despite the remarks of his learned friend, he said that stress did remain in a welded structure—not merely for 24 hours, as had been stated, but possibly for 24 years, if the structure would last for that period!

Relative costs could be debated for ever. All he asked was that they should be considered very carefully indeed before cast iron was replaced by a welded structure.

Weight Variations

With regard to variation of the weight of castings off the same pattern over a period of time, he said he knew of a casting, 9 ft. long, weighing 7¼ cwts., and which, strangely enough, was the column for an oxy-acetylene cutting plant. In six castings made over a period of 3 to 4 months there was a variation of only 10 lbs., or 1 per cent. in weight.

He asked the jury to bring in a verdict restraining the Defendant from poaching on the Plaintiff's coverts.

Finally, he said that in addressing a body of men so sane and obviously well-balanced as the members of the jury, he was reluctant to impute to them anything so frivolous as an interest in the science of betting on horse-racing. But if by some remote chance any of them happened to be at Epsom on the first Wednesday in June, and a shabby little man dressed as a jockey approached them and said, "Guvnor, I've got a cast-iron cert. for the 3 o'clock; you can put your blinkin' shirt on it," they should listen to him, and, on receiving his assurance, as no doubt they would, that it complied in every particular with Grade 3 of B.S.S. 786, they should pay him his refresher fee for the information, rush to the nearest bookmaker, take off their hats, coats, collars, ties and their blinkin' shirts, and place them with every confidence on that "cast-iron certainty."

SUMMING-UP BY PRESIDENT OF THE COURT

THE PRESIDENT OF THE COURT, addressing the jury, said they had listened with care and patience to the very admirable speeches of learned Counsel on both sides, who had appealed to their reason and sentiment, and also to their knowledge of past history. Counsel might have indicated the keynote of the civilisation of the Egyptians by the pyramids and sphinx; they might have led the jury to think of the standard of beauty in Greek columns; they might have led them to a view of civilisation by our modern conglomerations; welding and casting, too, might be indicative of present-day tendencies. But it was dangerous to delve too deeply into the past. He was reminded of the story of a gentleman who had sought to have his genealogical tree discovered, for which he had paid £1,000, and, on receiving it, had wanted to pay another £1,000 to hush it up!

It was his duty to direct the jury's attention to the observations made by learned Counsel on both sides, who had not failed to cast and/or fabricate some of the following ingots:—

(1) The Defendant ("Steel Fabrication, Esq.) was ugly.

(2) The Defendant had few, if any, curves.

(3) The Plaintiff ("Lord Ian Casting") had a heavy "base."

(4) The Plaintiff "required machining to his full length."

It had been said that casting was a "fabrication." In case members of the jury should be confused by those terms, he said they should attend to the legal aspect of the evidence, about which he directed them to find that the Cause had been brought to the attention of the wrong Court. Both sides had made certain remarks which, in his opinion, would form the basis of another action elsewhere and, he trusted, before another jury; furthermore, such a marriage as was envisaged by the Defendant "to train certain employees" might bring about at another Court an action in which the intervener would be "Lord Ian Filings"!

The Plaintiff, it would be noted, had admitted that certain castings might suffer from surface defects and that such faults might be effectively cured by the use of a welding process. The Defendant had suggested that the customer always had the last word; but the customer was not always right. He was reminded of the story of a shop assistant who had resigned his position in order to join the Police Force, where the customer was always wrong!

In the Cause before the Court, the Plaintiff sought an injunction restraining the Defendant from manufacturing, selling or causing to be sold certain types of structures which had hitherto been manufactured exclusively by the Plaintiff. The Plaintiff claimed that such structures were copies of his work, were uneconomic and had defects which were not present in his manufactures. The Plaintiff further claimed that his structures had qualities and usages which were not possible in the Defendant's structures, and that competition of that type was harmful to his business and was likely to cause hardship to his employees.

On the other hand, the Defendant opposed the injunction on the ground that his structures were not copies of the Plaintiff's structures, that they had definite qualities of light weight and strength and could be produced at less cost than those manufactured by the Plaintiff. The Defendant counter-claimed for the allotment of an agreed field of activity for his manufactures and offered to train certain employees of the Plaintiff in his type of manufacture, which would thus prevent hardship to the Plaintiff's employees.

It would appear that there might be room for both casting and welding as functions in the industrial technique of this country. The real "yard-stick" or tests were those of (1) economy of manufacture and (2) utility to industry and the consumer or user. It was, therefore, the duty of the jury, in the light of the statements of opposing Counsel, and with the deep conviction of the necessity for co-operation in these days of the mobilisation of industry for national purposes, that they should seriously apply their minds and give definite answers, yea or nay, to the following questions:—

(1) Had the Plaintiff proved his charge?

(2) Was he entitled to his claim for an injunction?

(3) Was the Defendant entitled to his counter-claim for an agreed field of activity?

Those questions must be answered plainly in the affirmative or negative.

THE VERDICT

The members of the jury retired to consider their verdict, and on returning to the Court their decision was announced as follows:—"The jury is of opinion that this Cause should never have been called. They consider that the differences between the parties could have been amicably settled, and they should work together in a common effort, each party seeking only that market which is essentially in the best interests of industry."

Vote of Thanks

On the motion of MR. A. RAMSAY MOON (Secretary, Institute of Welding), seconded by MR. C. C. BOOTH, J.P. (President of the London Branch of the Institute of British Foundrymen), a hearty vote of thanks was accorded Mr. Tudor Davies, Mr. Kershaw, Mr. Templeton, the members of the jury, Mr. Bainbridge and Dr. Everest for the enormous amount of work they had done in connection with the trial.

Pig-Iron and Steel Output

The British Iron and Steel Federation report that there were 83 blast furnaces blowing at the end of January, compared with 78 furnaces at the end of December, five furnaces having resumed operations during the month. The production of pig-iron in January was 500,500 tons, compared with 445,800 tons in December last and 461,500 tons in November. The January figures included 107,800 tons of hematite, 299,700 tons of basic, 79,300 tons of foundry, and 8,100 tons of forge pig-iron. The output of steel ingots and castings in January was 811,700 tons, compared with 655,700 tons in December last and 860,000 tons in November. As the holidays at Scottish steelworks continued into January, the effective working month in steel was shortened by the equivalent of roughly one day's output taking the industry as a whole. Following the reaction of end-of-year conditions upon production in December, activity has now regained the level of last November.

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The Week's News in Brief

Trade Talk

THE SHOTTS IRON COMPANY, LIMITED, have relit two blast furnaces at Shotts Iron Works, which have been damped down since last December.

SWAN, HUNTER AND WIGHAM RICHARDSON, LIMITED, Wallsend, have secured an order from the Port Line, London, for a motor vessel of 9,700 tons.

THE BRITISH IRON AND STEEL FEDERATION is holding its annual meeting in London to-day (Thursday). The annual banquet will be held in the evening at Grosvenor House, W.1.

THE PRIME MINISTER will be Minister in attendance on the King when he visits the Engineering and Hardware Section of the British Industries Fair at Birmingham on March 1.

A FURTHER CONFERENCE of the engineering employers and the unions will be held towards the end of the month. The unions are claiming a substantial increase in wages and the restoration of pre-June, 1931, working conditions.

AFTER A MEETING lasting ten days in Zurich, the International Malleable Tube Fittings Association, which also embraces American and Canadian interests, has prolonged the agreement for a period of several years. The British Malleable Tube Fittings Association is one of the parties to the agreement.

THE SCIENCE MUSEUM, South Kensington, has just received, as a loan from Mirrlees, Bickerton & Day, Limited, the Mirrlees-Diesel oil engine made by Mirrlees, Watson & Yaryan, of Glasgow, in 1897. This is the first Diesel engine made in Britain, and dates from the same year as that now in the Deutsches Museum at Munich, which was the first engine of this type to be sold in Germany.

NORTH-EAST SHIPYARDS, especially those on the Wear, Tees and West Hartlepool, are in urgent need of more work. Of the 17 yards in the area available for work, seven have empty building berths and several others have only one vessel on the stocks. Owing to its large amount of rearmament work the Tyne is not yet feeling acutely the shortage of mercantile contracts. On the River Wear five of the eight yards are empty.

A SPECIAL COMMITTEE to pool knowledge and experience of air-raid precautions to protect factory employees during working hours has been set up by the National Union of Manufacturers. Plans already in the hands of the committee show that some firms have chosen responsible air-raid precautions officers who have been, or are being, trained in fire fighting, anti-gas and decontamination and first aid. They in turn will teach their respective corps. Some factories have duplicated internal telephonic arrangements, shelters and first-aid stations have been designed or are being built; provision has been made for emergency lighting, food and water. As details are received the committee is making them available to any member who may require advice or help.

THE SCOTTISH district committee of the National Union of Foundry Workers, representing more than 7,000 members, is circularising the branches in support of a proposal to abolish overtime. An official stated recently that almost 50 per cent. of the moulders were unemployed, but other members were working excessive overtime because of the unsatisfactory conditions of the agreement regulating extra work. There was no moral justification for such conditions, in the opinion of committee, he added. It is suggested that resolutions be sent to the national executive to take a ballot vote of members for or against the present overtime and nightshift agreement being continued. The district committee and officials agree that overtime should be allowed in relation to casting and feeding, which are regarded as technical necessities, but otherwise overtime should be banned when so many members are unemployed.

THE DELEGATION which the Federation of British Industries is sending to Germany next month, in order to enter into official negotiations with the German Reichsgruppe Industrie on matters of common interest to the industries of the two countries, will be composed as follows:—Mr. Peter F. Bennett, O.B.E., J.P. (President of the Federation); Sir William Larke, K.B.E. (Chairman of the F.B.I. Tariffs and Commercial Relations Committee); Mr. Guy Locock, C.M.G. (Director of the Federation); Mr. R. Glenday, M.C. (Economic Adviser); Mr. C. F. I. Ramsden (Foreign Director); Mr. V. Watlington (Member of Grand Council), and Mr. F. E. Jordan (representative of F.B.I. in Germany). Mr. Peter Bennett has requested Sir William Larke, as Chairman of the F.B.I. Committee concerned, to be the official leader of the Delegation, as Mr. Benuett himself may not be able to be present during the whole period of the discussions.

Personal

MR. JAMES ROBERTSON, until recently works manager to the Welwyn Foundry Company, Limited, Welwyn Garden City, Herts, has been presented with a grandfather clock by employees of the firm.

SIR MAURICE E. DENNY, chairman of Wm. Denny & Bros., Limited, has been elected to the board of Guest, Keen & Nettlefolds, Limited, in succession to Sir Stephenson H. Kent, who has resigned.

MR. R. G. BLAKE, owing to pressure of work, has found it necessary to resign his position as director of Kayser, Ellison & Company, Limited. Mr. Blake's resignation has been accepted with regret. It is not proposed to fill the vacancy on the board at present.

MR. P. H. MILLS, managing director of W. & T. Avery, Limited, Soho Foundry, Smethwick, was elected President of the Birmingham, Wolverhampton and Staffordshire District Engineering and Allied Employers' Association recently, and Mr. Percy Pritchard, managing director of Birmid Industries, Limited, was appointed deputy president.

Will

HORSFALL, PERCY, of Halifax, chairman of Augusts, Limited, foundry equipment specialists £78,019

Obituary

MR. THOMAS TAYLOR, formerly works manager of the Wallsend Slipway & Engineering Company, Limited, has died, aged 72. He was in the service of the firm for 40 years.

GENERAL SIR NOEL BIRCH died on Friday, February 3, at the age of 73. He was a director of the English Steel Corporation, Limited, Vickers, Limited, and Vickers-Armstrongs, Limited.

MR. HERBERT JOHN DEACON, who died at Sheffield recently at the age of 67, worked until Christmas for Brown Bayley's Steel Works, Limited, by whom he had been employed for 52 years. He became senior assistant manager in the steel melting department.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

H. D. Evans' Foundries, Limited, Commercial Works, Roath Basin, Cardiff.—Capital, £3,000. Directors: H. D. Evans and M. A. Evans.

Hart & Martinson, Limited, Beaumont Fee, Lincoln.—Capital, £5,000. Manufacturers of stoves, ranges, etc. Directors: N. M. Bell, M. Jelley, D. H. Jelley and J. A. Bell.

Redman Tools & Products, Limited.—Capital, £3,500. Ironfounders, engineers, toolmakers, etc. Directors: A. M. Redman, 22, Fairfield Way, Kingston Hill, Ewell; G. G. Rees.

Robert Taylor & Company (Ironfounders), Limited, Muirhall Foundry, Muirhall Road, Larbert.—Capital, £25,000. Directors: R. Taylor, A. Sinclair, A. O'Beirne, and R. R. Taylor.

Alfred Ellis & Sons (Wakefield), Limited, Crown Works, Kirkgate, Wakefield, Yorks.—Capital, £4,000. Brass, bronze and aluminium founders. Directors: P. T. Ellis and G. Ellis.

Company Meetings

Aeroplane & Motor Aluminium Castings, Limited

An extraordinary general meeting of Aeroplane & Motor Aluminium Castings, Limited, was held in Birmingham last week, MR. A. R. WISE, M.P. (chairman), presiding, to consider a resolution increasing the capital of the company to a nominal £100,000, necessitated by continued expansion. Some of the increase in business, said the chairman, was due to rearmament work, but very satisfactory progress was being made in ordinary industrial channels, principally the motor industry. With the speeding up of the rearmament programme, their castings were sought by the aeroplane engine builders and others, and during the past two years the company had increased its production of such castings most favourably. X-ray apparatus was being installed to detect any internal defects in the castings. The directors felt that the business was so well established that whenever rearmament activities were reduced or concluded, the business should not unduly suffer. The resolution was approved.

Beans Industries, Limited

The annual meeting of Beans Industries, Limited, was held in Birmingham on February 8. MR. VICTOR RILEY (chairman) said that the company was rendering considerable assistance with the Government's Defence programme and, in addition, despite the falling off in trade experienced during part of the year in certain directions, the foundry and general engineering business continued to show healthy and steady progress. Further sums had been spent on the equipment of the foundry.

Company Reports

Lightalloys, Limited.—Interim dividend of 15 per cent.

Blakey's Boot Protectors, Limited.—Interim dividend of 7½ per cent.

International Nickel Company of Canada, Limited.—Quarterly dividend of 50 cents.

English Electric Company, Limited.—Net profit for 1938, after providing £50,000 as a reserve for N.D.C. and income-tax, £501,709; dividend on the ordinary stock of 10 per cent.

Forthcoming Events

FEBRUARY 17.

Institution of Mechanical Engineers:—Annual general meeting, at the Institution, Storey's Gate, London, S.W.1, at 5.30 p.m.

FEBRUARY 20—MARCH 3.

British Industries Fair:—Engineering and Hardware Section at Castle Bromwich, Birmingham, 10 a.m.-6 p.m.

FEBRUARY 22.

Institute of Metals (Sheffield Section):—"Metals of High Purity." Paper by Dr. C. H. Desch, F.R.S., at Mappin Hall, St. George's Square, Sheffield, at 7.30 p.m.

FEBRUARY 23.

Institute of Welding (South Wales Branch):—"Fusion-Welded Pressure Vessels." Paper by J. W. A. Thompson, at South Wales Institute of Engineers, Park Place, Cardiff, at 7 p.m.

FEBRUARY 24.

Manchester Association of Engineers:—"Modern Furnaces and Their Control." Paper by J. W. Holden, B.Met., at Engineers' Club, Manchester, at 7.15 p.m.

Institute of British Foundrymen

FEBRUARY 17.

Middlesbrough Branch:—"Fifty Years' Progress in Steel Moulding." Paper by F. Swift, at Cleveland Scientific and Technical Institution, Middlesbrough, at 7.45 p.m.

FEBRUARY 18.

Bristol Section:—"Light Castings and Their Manufacture." Paper by A. Burgess, at Merchant Venturers' Technical College, Bristol, at 7 p.m.

FEBRUARY 25.

East Midlands Branch:—Annual dinner at Loughborough.

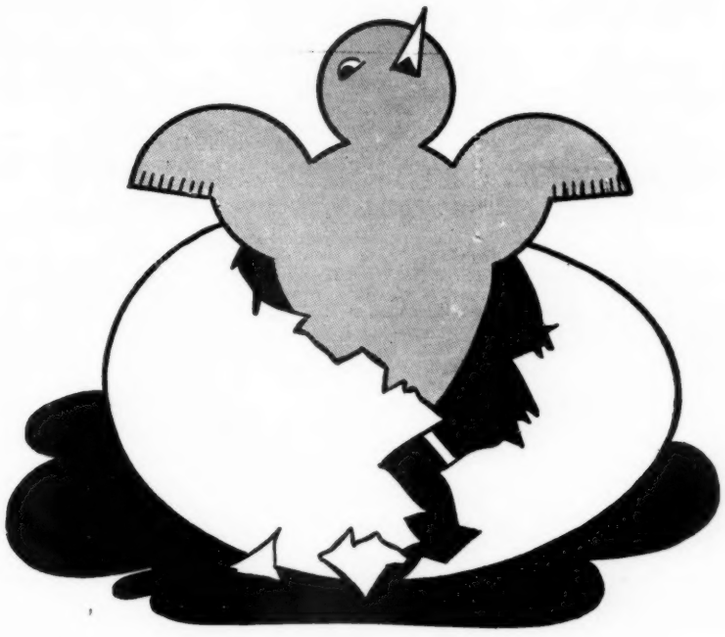
Newcastle-upon-Tyne Branch:—Works visit. Report of Cast-Iron Sub-Committee on the Properties of Grey Cast Iron, presented by E. B. Ellis, at Neville Hall, Newcastle-upon-Tyne, at 6.15 p.m.

Wales and Monmouth Branch:—"Factors in the Production of Electric Steel Castings." Paper by J. F. Gist, at University College, Cardiff, at 5 p.m.

The Institute of Vitreous Enamellers

FEBRUARY 23.

Scottish Section:—"Enamel Shop Troubles." Paper by S. W. Vickery, at Royal Technical College, Glasgow, at 7.30 p.m.



EASTER REPAIRS

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Raw Material Markets

There has been a rather freer call for contract deliveries of foundry pig-iron during the past few days, but new business still remains quiet and for early delivery only. Unless there is a marked improvement, several months of this year are likely to elapse before consumers have liquidated their existing contracts.

Pig-Iron

MIDDLESBROUGH.—There has been a very welcome change in the tone of the iron market in this area since the improvement in the international outlook, and during the past week there has been some inclination to place new orders, although these are for the most part of small dimensions. Nevertheless, it would appear to be certain that users are only waiting the time when they can buy forward with confidence before entering into long-term contracts. The more settled conditions have also been reflected in the export market, and a few small orders have been received. In view of the fact that scrap iron is plentifully available and at much lower prices than foundry iron, much of this material is being used in place of foundry iron by the local consumers.

Consumption of hematite is certainly on the upgrade, but, owing to the heavy stocks now on hand at the users' works, little new business is being done. Some consumers are supplementing existing stocks by purchasing small tonnages for early delivery. There is not much trade being done in the export section, but a few small tonnages of special qualities are changing hands. For delivery on the North-East Coast, East Coast mixed numbers are quoted at 120s., 125s. 6d. in Sheffield, and 131s. in the Midlands, all less 5s. per ton rebate.

LANCASHIRE.—The absence of forward buying of foundry iron is still very noticeable in this district, but small orders are quite freely placed. Consumers are intent on reducing their stocks to a minimum before re-entering the market for large tonnages. Apart from speciality concerns, which are busy, employment at the local foundries is far from satisfactory. For delivery to users in the Lancashire price zone, offers of Staffordshire and Derbyshire No. 3 foundry iron are on the basis of 104s., with Northamptonshire No. 3 at 102s. 6d., less 5s. rebate. Business in hematite is still quiet, while the call for supplies of Scotch foundry iron is equally dull. Offers of the latter range from 120s. to 122s. 6d., delivered.

MIDLANDS.—High-phosphorus pig-iron remains in poor demand on forward account, and, apart from a few orders for prompt deliveries, there is little business in the market. Short time is still prevalent at most of the light-castings foundries, and, seeing that this trade is the largest consumer of high-phosphorus iron, it is not difficult to account for the present quietude. On the other hand, the demand for low-phosphorus iron and hematite is tending further to expand. These grades are used mainly by the heavy-engineering concerns, while machine-tool makers and motor foundries are also substantial consumers of these qualities. The price of low-phosphorus iron is not controlled and current quotations range from £5 5s. to £6 per ton.

SCOTLAND.—There has been no improvement in the call for supplies of foundry iron, and only small tonnages are changing hands. Maybe the fact that prices are only fixed until further notice is causing users to wait, but, nevertheless, trade generally is unsatisfactory among the various consuming works. No. 1 foundry iron is quoted at 108s., with No. 3 at 105s. 6d., f.o.t. furnaces. The plight of the light-castings foundries in the Falkirk district is such that at times they are only working on one day per week. Supplies of iron from Cleveland and the Midlands are being offered here, but there is little or no demand. Business with the local steelworks is negligible, as they are mostly well covered ahead. Hematite mixed numbers are quoted at 120s. 6d., with basic at 92s. 6d. per ton, both delivered steelworks.

Coke

The foundry-coke market remains quite active, and the call for supplies is satisfactory. There has been more willingness on the part of consumers to book supplies for delivery up to the end of the first half of the year. The current minimum price of both Durham and Welsh coke is 50s. 6d. per ton.

Steel

Channels, tees and angles, which are required in connection with the Government's air-raid shelter scheme, are in good request, and it is likely that the demand for these will show a marked expansion within a short time. Makers of steel sheets are now working to capacity, and are likely to continue to be well employed for a good time to come. In almost every instance steelworks are now better situated than they have been for a considerable time past. Structural engineers, who are engaged on Government work, have recently placed orders for substantial tonnages of steel, and further orders are expected to emanate from this source. Orders from the tube trade for strip are being placed quite freely. Although certain sections of the steel trade are slow to improve, on the whole, the outlook is much better.

Scrap

It is understood that the National Federation of Scrap Iron and Steel Merchants is contemplating the appointment of a director to watch the interests of the trade and to carry out executive duties connected with it. Business in the scrap market has been much better within the past few days, largely under the stimulus provided by the steelworks, most of which are now showing renewed interest in buying additional tonnages. In South Wales, particularly, the demand from the steelworks has so much improved that many merchants are unable to meet the call for supplies without delay.

Metals

The weekly market report issued by Henry Gardner & Company, Limited, states that "although many industries are extremely busy, conditions in the non-ferrous metal markets are so idle that the increase in the unemployment figures did not excite much comment or cause any marked deterioration in sentiment. Indeed, business is so quiet that it is difficult to imagine that such a factor could reduce still further the present volume of demand, already so small. Opinion in America continues to be very mixed. Despite some sceptics, it appears to be divided between confidence in the further improvement in domestic industry resulting from the increased activity of the building trade, and a lack of confidence in trade anywhere when the international situation is considered. Fortunately, the latter at the moment has a rather more peaceful appearance, anyhow on the surface."

Copper.—Very dull conditions have prevailed in this market during the past week, and there has been little tendency on the part of consumers to take up further supplies. Buyers are content to cover their immediate requirements only. Japan and Sweden have been the most active sources of business, and moderate tonnages have been booked by consumers in these countries. Germany, formerly a substantial buyer, continues to refrain from further business. Trade in the United States also has been quiet.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £42 16s. 3d. to £42 17s. 6d.; Friday, £42 3s. 9d. to £42 6s. 3d.; Monday, £42 6s. 3d. to £42 7s. 6d.; Tuesday, £42 2s. 6d. to £42 5s.; Wednesday, £41 10s. to £41 11s. 3d.

Three Months.—Thursday, £43 2s. 6d. to £43 3s. 9d.; Friday, £42 11s. 3d. to £42 12s. 6d.; Monday, £42 12s. 6d. to £42 13s. 9d.; Tuesday, £42 8s. 9d. to £42 10s.; Wednesday, £41 15s. to £41 17s. 6d.

Tin.—Though buyers continue to pursue a very reserved policy, there has been a widening of the backwardation, due to the comparative scarcity of spot tin. There is no indication that there will be any early change in the outlook, and trade is expected to continue on a quiet scale until the international situation becomes more settled. Consumption in the United States is believed to be fairly satisfactory, but there has recently been little disposition to increase commitments. American tinplate mills are now operating at around 45 per cent. of capacity, and it is anticipated that there will be a further improvement in this position later in the year; it is expected that 1939 will be a better year for tinplates than was 1938.

Official quotations were as follow :—

Cash.—Thursday, £215 to £215 5s.; Friday, £214 10s. to £214 15s.; Monday, £214 to £214 5s.; Tuesday, £214 to £214 5s.; Wednesday, £212 15s. to £213.

Three Months.—Thursday, £213 15s. to £214; Friday, £213 to £213 5s.; Monday, £213 to £213 5s.; Tuesday, £212 15s. to £213; Wednesday, £211 15s. to £212.

Spelter.—Consumers are still buying in small tonnages for early delivery, and there has been almost an entire absence of long-term contracts. No improvement has been noticeable in the demand from the galvanisers. In this market, also, there has been less interest of late from Germany; it would seem that this country has about satisfied its requirements for armament purposes. The American Bureau of Metal Statistics reports that the world's output of zinc in December totalled 152,000 short tons, as compared with 145,000 tons in the previous month.

Daily market prices :—

Ordinary.—Thursday, £13 10s.; Friday, £13 10s.; Monday, £13 11s. 3d.; Tuesday, £13 10s.; Wednesday, £13 7s. 6d.

Lead.—Should the Government decide to follow the example of the Finsbury Borough Council and provide deep underground air-raid shelters, it is certain that the lead market would benefit very considerably. At the present time, the demand from the civil building industry is very small, although there should be an improvement in this respect in the spring. The turnover in the United States has been moderately satisfactory. World output of refined lead in December was 154,000 short tons, against 150,000 tons in November, according to the American Bureau of Metal Statistics.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £14 5s.; Friday, £14 5s.; Monday, £14 5s.; Tuesday, £14 3s. 9d.; Wednesday, £14 3s. 9d.

Scrap.—Business has been on a very small scale during the past week, and both home and export inquiries have been quiet. A hopeful feature of the market has been the resumption of buying interest by Germany. Although this is at present on the small side, it is anticipated that much larger orders will shortly be placed by this country.

Approximate selling prices for old metal:—New aluminium cuttings, £70; rolled, £54 to £55; cast, £32; foil, £80. Copper, £38 to £42; braziery, £35. Brass (clean), £21 to £24. Zinc, £10. Lead, £13 5s. Gunmetal, £38.

Contracts Open

Exeter, February 25.—Cast-iron pipes, iron castings, etc., for 12 months from April 1, for the City Council. Mr. R. H. Dymond, city engineer, Municipal Offices, Exeter.

Falkirk, February 27.—10,000 ft. of 10-in. dia. lapwelded steel pipes and specials, spun lined and sheathed with bitumen; 3,000 ft. of 7-in. dia. lapwelded steel pipes and specials, spun lined and sheathed with bitumen; 45 tons in all of 6-in., 5-in., 4-in. and 3-in. dia. cast-iron spigot and faucet pipes and specials (Classes C. and D.); 11 tons in all of 4-in. and 3-in. dia. cast-iron spigot and faucet pipes and specials (Class B.), for the Stirlingshire and Falkirk Water Board. Mr. John Cullen, engineer, Water Board Offices, Brockville, Falkirk.

Plympton St. Mary, February 20.—Cast-iron goods, pipes, etc.; brass-foundry goods; copper tubes and fittings; lead pipe, etc.; wrought-iron galvanised tube, fittings, etc., for one year from April 1, for the Rural District Council. Mr. P. T. Loosemore, clerk, Council Offices, Plympton, South Devon.

Billiton Aluminium Works

Billiton Maatschappij, the Netherlands Indian tin producing concern, issued on Friday last Fls. 3,500,000 (£400,000) ordinary shares at 250 per cent. exclusively to shareholders, in the proportion of one new for three old shares. Proceeds of the issue will go to the establishment of a large aluminium factory which is to be erected near the Assahan cataract in Central Sumatra.